Economic Review

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For decades, differences between energy-producing and energy-consuming regions helped shape U.S. energy policy. Now the differences appear to be subsiding as the economies of energy-producing and energy-consuming states become more alike in their response to changing energy prices. Two Dallas Fed economists expect this convergence to continue in ways that will affect U.S. energy policy.

Economic Review

Federal Reserve Bank of Dallas

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Mexico's Crisis: Looking Back To Assess the Future

David M. Gould
Senior Economist
Federal Reserve Bank of Dallas

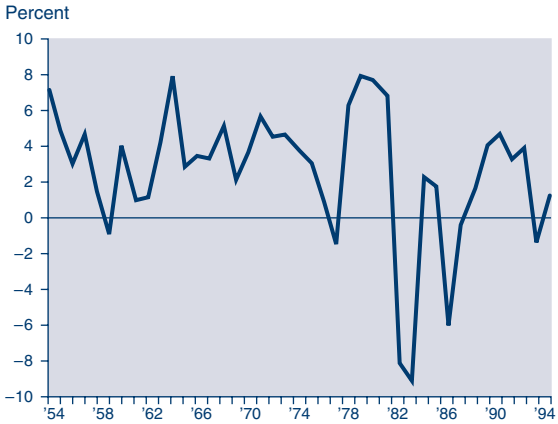
It may take several years for Mexico to fully regain the investor confidence lost during this recent economic crisis. However, the speed with which Mexico recovers will be fundamentally determined by the economic policies it chooses to follow. The more Mexico relies on open markets and stable macroeconomic policies, and the less it withdraws within itself, the faster the country will recover.

In early December 1994, the Organization for Economic Cooperation and Development (OECD) and many private economists were predicting that Mexico's real gross domestic product (GDP) would grow by at least 3.8 percent in 1995.[1] Mexico appeared to be on the fast track to economic growth and stability. For the first time in many years, its annual inflation rate was down to less than 10 percent, the public-sector budget was nearly balanced, and exports were growing at an annual rate in excess of 22 percent. Moreover, Mexico's entry into the North American Free Trade Agreement (NAFTA) and its recent uneventful presidential elections suggested a continuity in the country's economic reform policies.

A few weeks later, however, on December 20, 1994, international financial markets were rocked by the devaluation of the Mexican peso. Then, what first appeared to be a minor correction in Mexico's nominal exchange rate quickly developed into a broader financial crunch felt in and outside Mexico. By March 1995, the peso had fallen more than 50 percent against the dollar, and monthly inflation was growing at an annual rate in excess of 60 percent. Despite a $50 billion financial assistance package arranged in late January by the international community to help shore-up liquidity problems in Mexican dollar-denominated debt, interest rates on this debt remained twice as high as they were before the devaluation. The Mexican government now expects the country's real GDP to fall about 3 percent in 1995.

It may take several years for Mexico to fully regain the investor confidence lost during this recent economic crisis. However, the speed with which Mexico recovers will be fundamentally determined by the economic policies it chooses

Figure 1
Annual Growth Rate of Mexican Real Gross Domestic Product per Capita, 1954–94



SOURCES: Penn World Table, Version 5.6, 1995; International Monetary Fund.

to follow. The more Mexico relies on open markets and stable macroeconomic policies, and the less it withdraws within itself, the faster the country will recover.

The purpose of this article is to put Mexico's most recent economic crisis into broad historical context in order to assess the future trend in Mexico's economic policies. Like many developing countries during the 1980s, Mexico's economic paradigm shifted from a closed market, inward-looking development strategy to an open market, outward-oriented development strategy. Unlike the period leading up to the 1982 debt crisis, the period before the latest crisis was one in which markets were becoming more open, inflation was low, and the public-sector budget was nearly balanced. Although there are forces in Mexico pulling away from market reforms as well as toward them, the trend in Mexico's policies has been toward greater openness. These economic reform policies have made future openness a more credible policy.

The first section of this article examines the history leading up to Mexico's recent economic policies. Next, the article discusses Mexico's economic reform policies and how they have changed since the economic crisis began. The following section examines the factors that influence the credibility of Mexico's open market policies. The final section summarizes the likely trend in Mexico's policies.

The historical context

The years of inward orientation. The economic reform policies that Mexico undertook in the mid-1980s were a shift away from policies that began shortly after World War II. Like many developing countries in the early 1950s, Mexico pursued an *import-substitution industrialization policy.*[2] The government kept Mexican markets relatively closed to foreign competition, restricted foreign direct investment, and tightly regulated domestic financial markets.

The original impetus for closed market policies was the *dependency theory*, the idea that if poor countries want to grow, they have to break away from developed countries. Poor countries would have to start producing manufactured goods for themselves rather than continue to import these goods from developed countries in exchange for exports of primary goods. The fear was that poor countries would never catch up to the rich countries without major government intervention to manage international competition and support domestic industry.[3]

Despite the inherent problems of a closed, highly regulated economy, Mexico's real GDP per capita grew at an average annual rate of about 3.7 percent from 1954 to 1972 (*Figure 1*). Mexico did not grow as quickly as some other developing countries that followed more outward-oriented policies, such as Korea and Taiwan, but growth was stable and living standards were rising.[4] This period of Mexico's development has been referred to as *stabilizing development.*

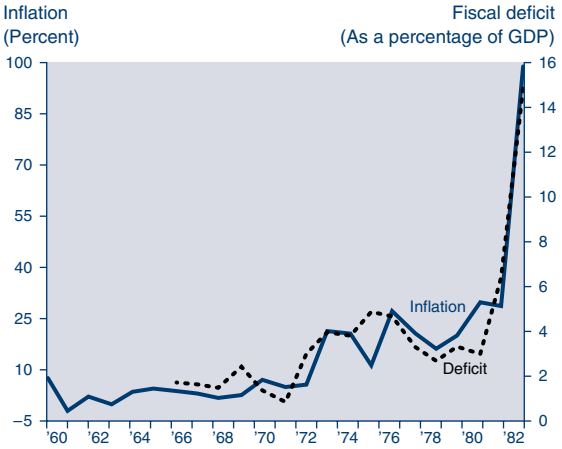
During the early 1970s, Mexico's inward-looking policies generated economic inefficiencies, but increased government spending during the period may have made these costs less apparent.[5] While per capita real GDP grew 3.7 percent from 1954 to 1972, it grew only slightly less, 3.1 percent, from 1973 to 1976. The microeconomic costs of price controls, a growing government sector, and inward-based industrialization policies were beginning to increase (Bazdresch and Levy 1991). Moreover, resources that might have otherwise been devoted to education and other productive investments were spent on subsidizing a growing number of the state-owned enterprises.[6] The world recession and the spike in oil prices that hit in 1973 only made matters worse for Mexico, which at the time was a net importer of oil (Lustig 1992).

In attempting to offset a slowdown in growth, Mexico pursed expansionary fiscal and monetary policies. However, as Table 1 and Figure 2 show,

Table 1
Mexican Economic Indicators, 1954–72 and 1973–76

	1954–72 (Percent)	1973–76 (Percent)
Real GDP per capita growth	3.7	3.1
Inflation	3.5	20.1
Public deficit/GDP	1.8	4.3
Current account deficit/GDP	–1.5	–2.9

Figure 2
Mexico's Inflation Rate and Fiscal Deficit, 1960–82



NOTE: Deficit data not available before 1966.

SOURCE: International Monetary Fund.

Table 2
Overview of Mexican Finances, 1954–94

Year	Population (In thousands)	Real GDP per capita (In U.S. dollars)	Real GDP per capita growth rate (Percent)	Inflation (Percent)	Nominal exchange rate (New pesos)	International reserves minus gold (Millions of U.S. dollars)
1954	31,419	2,397	7.15	4.85	.0125	147.08
1955	32,348	2,514	4.88	15.99	.0125	298.50
1956	33,483	2,590	3.02	4.85	.0125	344.50
1957	34,617	2,711	4.67	5.10	.0125	295.50
1958	35,757	2,751	1.48	8.17	.0125	247.50
1959	36,891	2,726	–.91	0	.0125	316.00
1960	38,227	2,836	4.04	7.59	.0125	306.00
1961	39,472	2,864	.99	–2.03	.0125	301.00
1962	40,754	2,897	1.15	2.15	.0125	333.00
1963	42,074	3,019	4.21	–.11	.0125	409.00
1964	43,446	3,258	7.92	3.55	.0125	418.00
1965	44,337	3,351	2.85	4.50	.0125	379.50
1966	46,337	3,467	3.46	3.77	.0125	454.99
1967	47,868	3,582	3.32	3.05	.0125	420.00
1968	49,451	3,766	5.14	1.76	.0125	491.92
1969	51,081	3,846	2.12	2.60	.0125	493.39
1970	52,770	3,987	3.67	7.06	.0125	568.10
1971	51,982	4,213	5.67	4.95	.0125	752.09
1972	53,690	4,404	4.53	5.66	.0125	975.88
1973	55,429	4,609	4.65	21.35	.0125	1,160.21
1974	57,165	4,782	3.75	20.60	.0125	1,237.63
1975	58,876	4,928	3.05	11.31	.0125	1,383.46
1976	60,560	4,973	.91	27.20	.0200	1,188.00
1977	62,211	4,900	–1.47	20.67	.0227	1,648.90
1978	63,836	5,208	6.29	16.17	.0227	1,841.51
1979	65,445	5,621	7.93	20.04	.0228	2,071.71
1980	67,046	6,054	7.70	29.78	.0233	2,959.89
1981	68,637	6,467	6.82	28.68	.0262	4,074.36
1982	70,225	5,942	–8.12	98.87	.0965	833.89
1983	71,791	5,401	–9.10	80.77	.1439	3,912.92
1984	73,309	5,524	2.28	59.17	.1926	7,272.04
1985	74,766	5,621	1.76	63.74	.3717	4,906.40
1986	76,178	5,283	–6.01	105.75	.9235	5,669.82
1987	77,562	5,262	–.40	159.16	2.2097	12,464.08
1988	78,933	5,349	1.65	51.66	2.2810	5,278.68
1989	80,312	5,566	4.06	19.70	2.6410	6,329.10
1990	81,724	5,827	4.69	29.93	2.9454	9,862.90
1991	83,306	6,018	3.28	18.80	3.0710	17,725.52
1992	84,967	6,253	3.90	11.94	3.1154	18,941.96
1993	86,557	6,167	–1.38	8.01	3.1059	25,109.61
1994*	88,054	6,244	1.25	7.00	5.0800	6,148.00

*Estimate.

NOTE: Data are for the end of the period. Real GDP is shown in terms of 1985 U.S. dollars and is adjusted for differences in purchasing power (using an equivalent basket of goods) between the United States and Mexico.

SOURCES: International Monetary Fund International Financial Statistics; Penn World Table, Version 5.6, 1995; Banco de México.

expansionary policies without real fundamental economic change simply generated inflation and large fiscal and current account deficits. In 1976, a balance of payments crisis erupted and led to a 60-percent devaluation in the peso, which had been fixed at 12.50 old pesos per dollar since 1954 (*Table 2*).

If macroeconomic policies had been as stable as they were in the 1950s and 1960s, Mexico might have been able to avoid the balance of payments crisis in 1976, even without structural change. But Mexico's increasing economic inefficiencies would have necessitated, at some point, fundamental change.

Mexico was ready for structural change in 1976, but huge oil discoveries appeared to lift fiscal and foreign exchange constraints, at least for the foreseeable future. Rather than implement the needed but difficult structural reforms, the new administration of President José López Portillo, expecting uninterrupted oil revenues, set out on a massive fiscal expansion. Without tight budgetary constraints, the state devoted more and more resources to purchasing private-sector firms that were no longer economically viable, with the hope of maintaining employment (Bazdresch and Levy 1991, 249). From 1950 to 1970, the number of para-statal firms in Mexico remained below 300; twelve years later, state-owned firms numbered 1,155. In 1983, state-owned firms accounted for 18.5 percent of GDP and employed more than 10 percent of the population (Aspe 1993, 181). Firms owned by the government included businesses such as the national oil company (PEMEX), the airlines (Aeromexico and Mexicana), the national telephone company (TELMEX), sugar refineries, and hotels.

Mexico's economic boom turn to bust when oil prices began to fall and U.S. real interest rates began to rise in mid-1981. The fixed exchange rate became extremely overvalued as the economic fundamentals changed. Investors' fear of another balance of payments crisis and devaluation led to capital flight. The government tried to maintain the exchange rate as long as it could, but foreign reserves were dwindling rapidly. In 1982, the government devalued the currency by more than 260 percent, declared a temporary moratorium on debt payments, and forced the conversion of dollar-denominated bank deposits into pesos at an unfavorable, below-market exchange rate.

As the crisis worsened, the government responded by tightening its grip on the economy. Toward late 1982, all trade became regulated, full exchange controls on capital were adopted, and the Mexican banking system was nationalized. But more government intervention spooked the financial markets and only made matters worse. With the Mexican financial markets in disarray, a government fiscal crisis, and inflation pushing an annual rate of 100 percent, real per capita GDP declined 8.1 percent in 1982 and 9.1 percent in 1983.

Hindsight is always better than foresight. By 1982, it was obvious that Mexico should have pursued more market-based policies and limited foreign borrowing. However, with the price of oil increasing quite rapidly during the late 1970s, and expectations of further price increases (expectations that other countries shared as well), the pressing need for change was not apparent (Lustig 1992, 21).

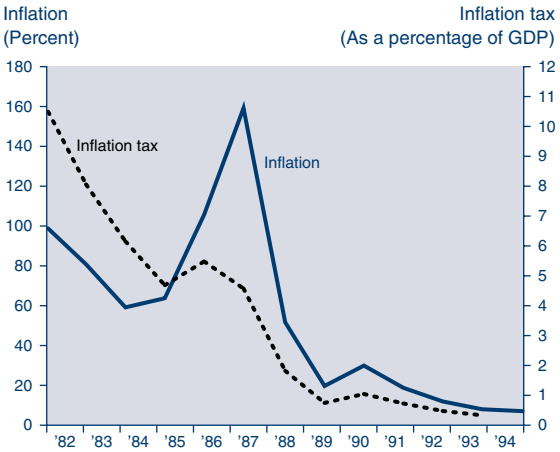
The transition years. In late 1982, Mexico's newly elected president, Miguel De la Madrid Hurtado, inherited perhaps the worst economic crisis in the country's history. During the early years of De la Madrid's administration, the first important stages of reform began, but it was only toward the end of his administration that structural reform policies genuinely moved in the direction of a more market-based economy.

From 1982 to 1985, Mexico's annual rate of inflation slowed from around 100 percent to about 65 percent in response to government spending cuts and tighter monetary policy. Real GDP per capita declined about 13 percent over these years as the economy adjusted to lower government spending and large foreign debt payments. Due to the high debt payments, Mexico's net transfers to the rest of the world totaled nearly 6 percent of GDP from 1982 to 1985 (Aspe 1993, 35).

Although the De la Madrid administration began reducing the public-sector deficit, it was not eliminating other fundamental causes of macroeconomic instability. Anti-inflation policies were not credible because the government still relied heavily on excessive money growth to earn inflation tax revenues. The inflation tax as a share of GDP was 8 percent in 1983 and 5.5 percent in 1985 (*Figure 3*).[7] The need for inflation tax revenues was due to debt payments, financial support of state-owned enterprises, and a weak tax system. Inflation began to accelerate in 1985, and by 1986, it was back up to more than 100 percent a year.

Although the economy was opening to trade, it was still relatively closed and the private sector was uncertain about the government's true

Figure 3
Mexico's Inflation Rate and Inflation Tax, 1982–94



SOURCE OF PRIMARY DATA: International Monetary Fund.

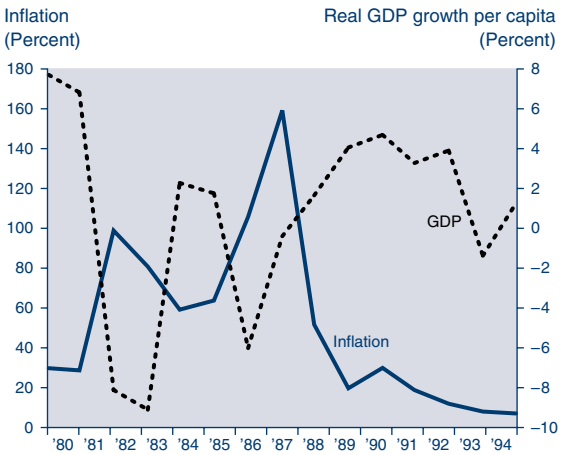
commitment to open markets. Thirty-five percent of imports had to be licensed, and quotas covered 83 percent of the value of imports (Aspe 1993, 156). The export sector was being held back because resources were kept in import-competing sectors. Foreign investment was also weak because investors were suspicious of Mexico's commitment to open markets; laws still limited foreign ownership of business, and the government controlled the banking sector. The macroeconomic environment continued to worsen. After an earthquake in 1985, another oil shock in 1986, and a stock market crash in 1987, Mexico was ready for rapid and far-reaching reforms. The next package of reforms began to address some of Mexico's worst structural problems.

The move to open market-based policies

During the early 1980s, Mexico's drop in real per capita income was almost as large as that which occurred during the Great Depression. As Figure 4 shows, in 1982 real per capita GDP fell 8.1 percent, while inflation rose to an annual rate of 98.9 percent. The experience convinced many people in and outside the government that Mexican policies were not working and they had to find an alternative (Aspe 1993, 14). Certainly, there were those, mainly in the protected and state-owned sectors, who resisted changes in policy. But as the economy continued to contract, their political clout waned. The country embarked on a new policy direction.

In December 1987, President De la Madrid and representatives of the labor, farming, and business sectors signed the Pact for Economic Solidarity, which was followed by the Pact for Stability and Economic Growth under the newly elected administration of President Salinas de Gortari. These two measures, now jointly referred to as the *Pacto*, were designed to combine orthodox fiscal and monetary restraint with structural reforms and an incomes policy (controls on wages and prices).

Figure 4
Real GDP Growth per Capita and Mexican Inflation, 1980–94



SOURCES: Penn World Table, Version 5.6, 1995; International Monetary Fund.

The Pacto has gone through 15 phases (or *renegotiations*, as they have been called) since its implementation in 1987.[8] The Pacto phases began as very short-term commitments, lasting about two months; they then grew to longer term, one-year commitments.[9] During the first phases, a strong emphasis was placed on price and wage controls, fiscal and macroeconomic adjustment, and debt renegotiation; later stages focused on deregulation and privatization to promote economic efficiency and on trade and financial liberalization to enhance competition and reduce production costs (Schwartz 1994).

Incomes policy. The incomes policy, or price and wage controls, has been and remains the most controversial part of the Pacto. Wage controls included programs that simply limited nominal wage increases, as well as more complicated schemes of linking nominal wage increases to productivity growth. Price controls were not uniform across the economy; the intention was to focus the controls on the leading sectors. Some have contended that the incomes policy was necessary to break the cycle of increasing inflation resulting from the practice of indexing wages and prices to past inflation (Lustig 1992, 52). Others, however, have argued that the incomes policy was unnecessary because, without fiscal and monetary austerity, the lifting of price controls would simply result in a return to high inflation.

Fiscal and monetary austerity are sufficient to stop inflation, but some have claimed that a benefit of the incomes policy was that it served to announce the government's intentions to all concerned parties. An explicit statement of the government's goals may have informed individuals what the inflation targets were, which could have decreased the costs of adjustment. However, price and wage controls, by themselves, can be costly because they tend to distort relative prices in an economy. The exact cost or benefit of Mexico's incomes policy has yet to be quantified.

The incomes policy was the most hotly debated during the first few months of the Pacto, when prices and wages were adjusted on a monthly basis according to changes in expected inflation. As inflation subsided, price and wage controls became a less contentious policy. High

inflation expectations were no longer automatically built into wage contracts, and the strength of labor unions to negotiate large wage increases declined. Although the December 1994 exchange rate devaluation was followed by higher inflation and attempts to impose more stringent price and wage controls, the government subsequently abandoned further attempts to impose controls.[10]

Public finance. An important element of the Pacto has been public finance policy. In addition to fiscal austerity, there has been a realignment of public-sector goods prices to reflect costs, the divestiture of state-run enterprises, and changes in the tax structure. An often observed difficulty with plans to reduce fiscal deficits, not just in Mexico but also in other countries undergoing economic reforms, is their structural inconsistency with other objectives. In other words, a government may state that the fiscal budget will be balanced and inflation will be reduced, but without a functioning tax system, inflation may be the only way to finance public expenditure. Although Mexico still has fiscal problems, changes in the public sector have made fiscal prudence a more feasible policy than during the early 1980s.

Of the 1,155 enterprises held by the public sector in 1982, 940 were either sold to the private sector, liquidated, or merged by 1994. State-owned enterprise expenditures fell from around 18 percent of GDP in 1983 to 9.6 percent of GDP in 1994. The recent economic stabilization plan for Mexico calls for further privatization of ports, public utilities, and some petrochemical plants. However, some of these proposed privatizations are being contested, and PEMEX, the national oil company and the largest state-run business, is not currently being considered for privatization.

Since 1989, the tax system has been simplified, and tax rates are down to levels similar to those in the United States. The corporate tax rate was reduced from 42 percent to 35 percent, and the highest income tax rate paid by individuals fell from 50 percent to 35 percent. By simplifying the tax structure, lowering tax rates, and increasing enforcement, tax evasion has fallen and tax revenue has increased. In the early 1990s, tax revenues increased nearly 30 percent, mostly as a result of Mexico's expanding tax base (Aspe 1993, 108). The overall fiscal deficit as a percentage of GDP fell from 16 percent in 1987 to 0.3 percent in 1994.[11] During the same period, total government spending fell from 43.7 percent of GDP to 26.3 percent of GDP, and inflation fell from 160 percent a year to 7 percent a year.

Mexico's stabilization plan of March 9, 1995, calls for increases in the prices of fuel, electricity, natural gas, and other goods and services provided by the public sector to reflect international prices and increase revenues. There are also plans to raise the value-added tax from 10 to 15 percent, reduce public-sector employment, and limit the growth of public-sector real wages.

Financial liberalization. An important element of Mexico's new reform policies has been financial liberalization. Financial liberalization took a major step forward after 1988 with the elimination of compulsory bank reserve requirements and forced credit to public-sector enterprises. The elimination of these measures allowed greater financing for private-sector enterprises. Other changes have been the authorization of universal banking and other financial entities. In 1991–92, the government privatized all the banks and lifted capital controls imposed after the 1982 crisis.

Mexico is now increasing access to foreign banks and brokerage houses. In October 1994, Mexico authorized virtually all the foreign banks, brokerages, and insurance companies that sought entry into the market. The finance ministry issued fifty-two licenses to eighteen commercial banks, sixteen securities firms, twelve insurance companies, five financial groups, and a leasing company.

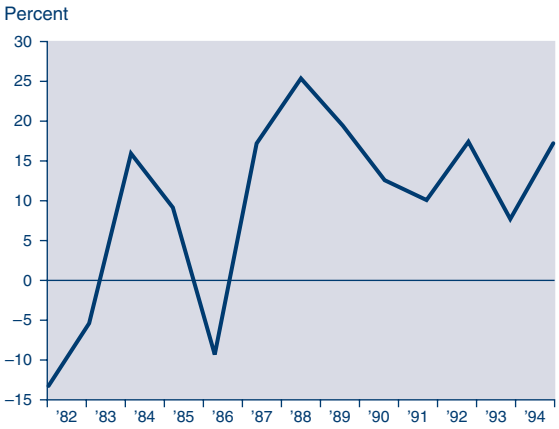
Because of the recent economic crisis and stress on the banking system, the government has pledged to speed up implementation of provisions that would allow greater foreign ownership of existing financial institutions. Foreigners will be able to hold majority interests in all but the three largest banks. Before the recent economic crisis, foreign ownership of existing banks was severely limited, although the banking sector still faced increased competition in the market. In 1991, Mexico's three largest banks—Banamex, Bancomer, and Serfin—accounted for about 62 percent of total Mexican banking assets; in late 1994, they accounted for less than 50 percent.

Since the December 1994 devaluation, there has also been an easing of the rules keeping financial institutions from using the futures market to hedge uncertainty. Prior to the devaluation, the development of a futures market to hedge peso and equity volatility was suppressed. But although the government felt that these markets would add to unwanted speculation against the currency, the markets may have led to greater flows of trade and investment. The rules now allow for Mexican institutions to hedge movements in the peso and the stock market.

Trade liberalization. On the trade side, Mexico started to gradually liberalize in mid-1985, but the process was solidified in 1988 when the number of goods covered by import licenses fell dramatically and the tariff structure was simplified. In

Figure 5

Annual Growth Rate of Trade (Exports Plus Imports) Between the United States And Mexico, 1982–94



NOTE: 1994 data annualized from first- and second-quarter data

SOURCE: International Monetary Fund.

1983, the share of imports covered by import permits was close to 100 percent; by 1992, the share had fallen to less than 2 percent (Banco de México 1993). Mexico joined the General Agreement on Tariffs and Trade (GATT) in 1986 and cemented its open trade stance with the United States and Canada through NAFTA in 1993. NAFTA has generated a large increase in trade and joint business ventures between U.S. and Mexican firms. For example, total trade flows between the United States and Mexico (exports plus imports) grew by around 17 percent in 1994, compared with a 7-percent annual rate in 1993. These trade flows have averaged about 15-percent growth since 1988 (*Figure 5*). Mexico is now vying with Japan to be our second largest trading partner behind Canada.

Monetary and exchange rate policy. When Mexico began its economic reform, the key element of its monetary policy was the use of the exchange rate as a nominal anchor—that is, domestic prices were tethered to international prices by targeting the nominal exchange rate. During the initial stages of the Pacto, the exchange rate was fixed to the dollar; then it was held to a preannounced daily depreciation. In 1991, the exchange rate was allowed to float within a widening band. At first, the top of the band rose 20 centavos (0.0002 new pesos) per dollar a day; then it was increased to 40 centavos (0.0004 new pesos) per dollar a day (*Figure 6*). On December 20, 1994, however, under pressure from foreign exchange markets and dwindling foreign exchange reserves, Mexico abandoned its exchange rate band. The peso was devalued and then allowed to float freely against the dollar.

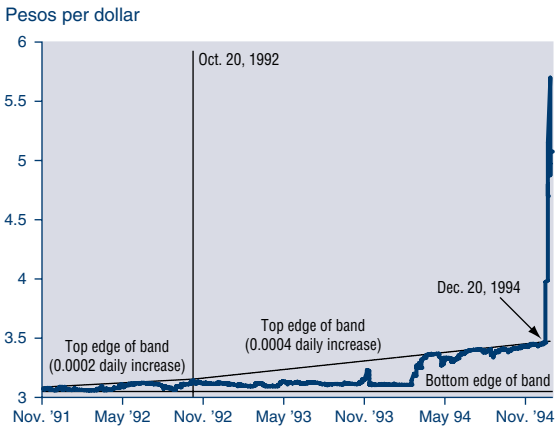
Some have argued that keeping the exchange rate closely tied to the dollar, especially during the early stages of Mexico's economic reforms, kept exchange rate volatility low and allowed investors a simple means of monitoring Mexico's monetary policy. For example, if expected inflation was higher in Mexico than in the United States or prospects for growth in Mexico weakened relative to those in the United States, dollars would leave Mexico seeking better returns in the United States. This would lead to upward pressure on the exchange rate (increase the number of pesos per dollar) as people who hold pesos buy U.S. dollars. If the exchange rate was to be kept within the band, Mexico would need to tighten monetary policy and increase interest rates to attract dollars back into Mexico. As long as the exchange rate policy was maintained and was credible, it was argued, anyone who watched the movement of foreign reserves would know what would happen to monetary policy.

Of course, exchange rate policy does not make low inflation credible. Low inflation is made credible only through sustainable fiscal balances and low and stable monetary growth. Over the long run, it is these policies that keep exchange rate policy credible, not the other way around. If monetary policy is too loose and is inconsistent with maintaining the exchange rate, foreign reserves leave the country. Without any foreign reserves to defend the exchange rate, the exchange rate policy has to be abandoned.

From 1987 to the end of 1993, Mexico's monetary policy was consistent with low inflation and maintaining its exchange rate targets. Inflation fell from a high of nearly 160 percent in 1987 to around 7 percent in 1994. During 1994, however, political uncertainty in Mexico and rising

Figure 6

Peso–Dollar Exchange Rate



SOURCE: Banco de México.

interest rates in the United States began to drain Mexican foreign reserves. Investors were not being fully compensated for the greater perceived risks in the Mexican market so they took their money elsewhere. Money left the country because interest rates did not rise sufficiently. A contributing factor could have also been that peso risks were difficult to hedge against. The central bank was suppressing the peso futures market because it feared the market would allow for inordinate speculation against the currency. Foreign reserves fell from around $25 billion at the end of 1993 to about $16 billion in July 1994 (*Figure* 7).

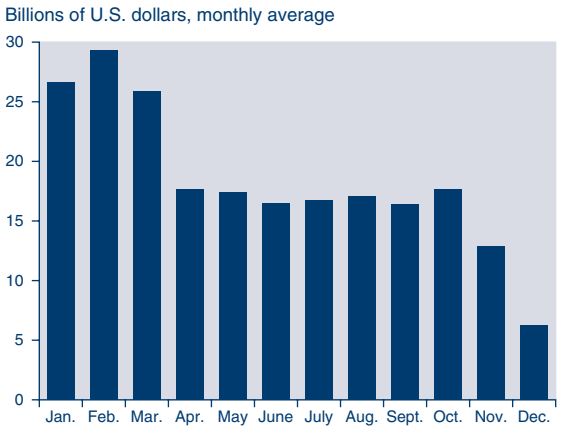
The election of Ernesto Zedillo in August 1994 brought new confidence in Mexico's policies and temporarily boosted foreign reserves and the peso. Following the elections, however, because of higher U.S. interest rates and increased investor uncertainty, money began flowing out of Mexico again. Without dramatically higher interest rates, foreign reserves continued to leave the country. Eventually, foreign reserves dwindled to such a point that the exchange rate band had to be loosened and then completely abandoned after continued pressure on the peso.

If interest rates had been kept higher after the 1994 presidential elections, perhaps the costs of abandoning the exchange rate, in terms of lost credibility and higher short-run inflation, could have been avoided. In hindsight, this may have been a better option than the one chosen, although dramatically higher interest rates could have also sparked an economic crisis. Perhaps a better option would have been to let the exchange rate float when foreign reserves were coming into the country, such as in late 1993. A floating exchange rate allows a country to weather domestic and international economic shocks without necessitating dramatic changes in domestic monetary policy and without calling into question the credibility of basic policies. Now that Mexico is floating its exchange rate, economic ups and downs will not generate speculation against a particular exchange rate policy. If monetary restraint continues, inflation—over the long run—will remain moderate.

Assessing Mexico's policy credibility

What determines credibility. Perhaps economic liberalization never comes without a crisis. This has certainly been the case in Mexico. What becomes evident from looking across a broad spectrum of countries that have embarked on economic reform is that some have achieved great success, while others have failed miserably.[12]

Figure 7
Mexico's Stock of International Reserves Less Gold, 1994



SOURCE: International Monetary Fund.

For example, Peru's trade liberalization attempt during the early 1980s was abandoned shortly after it was implemented. Will Mexico's economic reforms continue?

A common element of unsuccessful liberalizations seems to be the failure to create a credible economic policy. An example would be a government's pursuit of low inflation without addressing far-reaching structural problems, such as an inadequate tax system and a large budget deficit. In this case, pursuit of low inflation is inconsistent with the budget deficit and an inability to tax except through inflation.

Another credibility problem occurs when a government's policies are time-inconsistent. A time-inconsistent policy is one in which the government, at some later date, has an incentive to break it's promise. For example, the government, for political reasons, may have an incentive to redistribute income from the rich to the poor.[13] Under this objective, a free trade policy may not be credible because the government has an incentive to provide more protection than expected to import-competing firms whenever the relative price of imports decreases. When the price of imports falls, the import-competing sector becomes relatively poor; consequently, the government has an incentive to renege on its free trade promise and redistribute income through protection to these sectors. Free trade, then, is not a credible policy because the private sector understands the government incentive structure.

Creating a credible policy that is time-consistent can be problematic because it depends on the government's ability to precommit to a particular policy. In trade reform, for example, if a government cannot precommit to free trade, it may have to pursue a time-consistent but second-

best policy of partial tariff protection. In other words, the government may never be able to create a credible policy committed to complete free trade; it may, however, be able to create a credible policy with less protection.

Consequently, to evaluate the credibility of any particular economic policy two questions have to be addressed: (1) Is the policy consistent with other objectives being pursued at the same time? and (2) Is the policy time-consistent? In other words, does the government have an incentive to renege on the policy commitment? In the political economy context, the second question can be thought of addressing whether the political forces that determine a particular policy are likely to change.

Almost universally, no policy—whether in a developed country like the United States or developing country like Mexico—is completely credible. The lack of information about the government's incentives and uncertainty about future economic shocks makes complete credibility impossible. However, the degree of policy credibility can be subjectively assessed by examining factors such as the government's behavior over time, the country's institutions, and the consistency of policies.

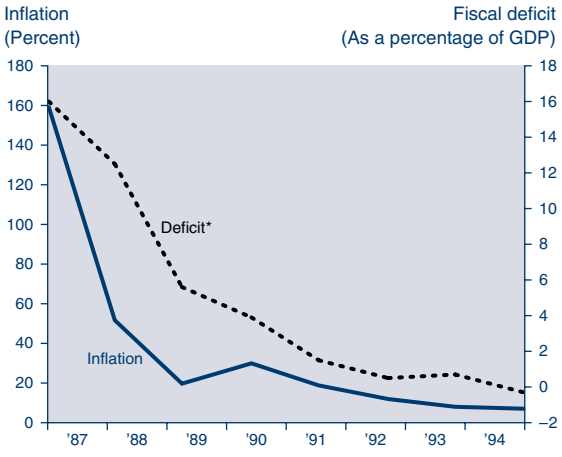
Assessing the credibility of Mexico's economic liberalization. Since the December 1994 devaluation, Mexico's economic growth has stalled, and a growing number of people have become disenchanted with the current economic situation.[14] High interest rates have made it difficult for people to service their debts and have caused a decline in spending. While the economic crisis could generate a political stimulus for greater economic liberalization and macroeconomic stability, it could also cause the abandonment of policies that enhance long-run growth in order to ease the short-run pains of adjustment. So far, the policies that have been adopted since the crisis began have favored greater economic liberalization and long-run macroeconomic stability, but their credibility over time will be determined by their consistency with other objectives and the strength of the constituency groups that favor such policies.

Because of Mexico's recent exchange rate devaluation, the credibility of another fixed exchange rate policy in Mexico is obviously very low. Mexico's past monetary policy, although it generated a relatively low rate of inflation, was not consistent with its rigid exchange rate band. Its current floating exchange rate regime, however, is more credible because it does not require any specific commitment to tie Mexico's monetary policy to that of the United States. In addition, while a floating exchange rate may be more volatile on a day-to-day basis, it is unlikely to experience the kind of large discrete jump that is often seen in managed exchange rate regimes.

Compared with the period after the 1982 crisis and devaluation, however, Mexico may have a more credible low inflation policy. Although inflation has dramatically increased since the December 1994 devaluation, over the longer run Mexico may be in a better position to avoid high inflation. Unlike the situation during the 1982 economic crisis, the Mexican economy now has fewer government-owned enterprises that are taking funds from the public sector; many of these businesses have been privatized or liquidated. Moreover, the government budget is not in a large deficit, and because of a better tax system, the government does not have to rely solely on the inflation tax (printing money to pay for government expenses) to collect revenues (*Figures 3 and 8*).

Government incentives to maintain a more stable macroeconomic environment may also be higher today than in the past. Unlike the early 1980s, economic interdependence is much more important in Mexico today. Trade as a share of GDP increased from 8.7 percent in 1982 to 22.1 percent in 1993. The benefits of foreign investment and its sensitivity to bad policy choices have also become more obvious over the last decade. Countries that are more open and outward oriented—such as Chile, Hong Kong, Korea, Singapore, and Taiwan—have achieved much higher sustained economic growth than more closed, inward-oriented economies.[15]

Figure 8
Mexico's Inflation Rate and Fiscal Deficit, 1987–94



* Public-sector borrowing requirements.

SOURCES: Banco de México (1994); International Monetary Fund.

The importance of market-based policies is apparent in Mexico's own experience. As discussed earlier, import-substitution industrialization policies were very costly for Mexico in terms of diminished economic efficiency and long-run growth. Moreover, while Mexico's 1982 crisis certainly hurt the country terribly, the poor policy response afterward, such as the nationalization of the banking industry, turned a bad situation worse by creating a massive capital flight for which Mexico paid a tremendous price. Despite the recent exchange rate crisis, Mexico has yet to reverse its open market stance.

Institutional arrangements can also increase the credibility of a policy. Although Mexico unilaterally reduced trade barriers in several areas before joining NAFTA and GATT, these multilateral agreements may be a much stronger commitment to future open markets, and not just because they are international agreements.

Free trade agreements create domestic coalitions against increases in domestic protection because of the threat of retaliatory response and possible collapse of the entire agreement. The greater the move to free trade, the more at stake and the greater the strength of these free trade coalitions. Usually, it does not pay for any one group to lobby against a single protective policy if the costs of such a policy to that group are relatively small. However, with NAFTA, a Mexican exporter has much more of an incentive to lobby actively against increases in Mexican protection because an increase in protection could induce a retaliatory response against its own products from the United States or Canada. The Mexican consumer also has a stake in seeing that the free trade agreement is kept because of the potentially large increase in the price of consumer goods if NAFTA is abandoned.[16]

Even though there may be coalitions in favor of sustaining open markets, in some sectors there is likely to be backsliding. Like the United States, Mexico is now using antidumping and countervailing duties against imports much more than in the past. Despite the fact that average tariff rates fell from around 34 percent in 1985 to 4 percent in 1992, the coverage of nontariff barriers went from 12.7 percent of imports in 1985–87 to 20 percent of imports in 1991–92 (Edwards 1993). The devaluation of the peso, however, may weaken the demand for nontariff barriers in Mexico. As the real value of the peso (adjusted for Mexican and U.S. inflation rates) has fallen against the dollar, the price pressure on import-competing firms in Mexico has decreased.

Conclusion

While continued economic reforms are not guaranteed in Mexico, they are more likely than is often believed. During the 1980s, Mexico's economic paradigm shifted from a closed market, inward-looking development strategy to an open market, outward-oriented development strategy. Unlike the period prior to Mexico's 1982 debt crisis, the trend in Mexico's economic policies has been toward greater economic integration in the world economy and a reduced reliance on the government sector. This trend in Mexico's policies, although not immune to shocks, is more consistent with future low inflation and greater economic growth than the country's previous inward-oriented policies.

Notes

Catherine Mansell Carstens, Ken Emery, Steve Kamin, Moisés Schwartz, Sidney Weintraub, and Carlos Zarazaga offered many helpful comments for this article. All remaining errors are solely my responsibility.

1 In December 1994, the Blue Chip consensus forecast for 1995 Mexican real GDP growth was 3.8 percent. The OECD was predicting 4-percent growth for 1995 and 4.3-percent growth for 1996.

2 One of the main architects of this policy was Raúl Prebisch. For an insightful analysis of Prebisch's views, see Love (1980).

3 The underpinnings of this theory was the idea that as world income rose, the demand for manufactured products would increase relative to primary products, and this change would lead to a lower relative price for primary products in international markets. As a result, if developing countries did nothing to change the structure of their output, their terms of trade would always move against them.

4 Over the same period, Taiwan and Korea both experienced around 4.6-percent real GDP growth per capita.

5 Although Prebisch was one of the main architects of the import-substitution industrialization policy, he realized the problems of protectionism as early as 1963. Hirschman (1968) quotes a very interesting passage from Prebisch (1963, 71): "As is well known, the proliferation of industries of every kind in a closed market has deprived the Latin American countries of the advantages of specialization and economies of scale, and owing to the protection afforded by excessive tariff duties and restrictions, a healthy form of internal competition has failed to develop, to the detriment of efficient production."

6 Gil Díaz (1984). As price controls were imposed to limit inflation, the profit margins of some private firms were squeezed. Those firms that could no longer produce profitably at the given prices were then purchased by the government. This was the case, for example, with sugar mills.

[7] The real output that a government obtains by printing money and spending it is called the inflation tax or seigniorage. Money creation that leads to inflation erodes the real value of nominal money holdings. The formula used here to calculate the inflation tax as a share of GDP is: $INFTAX = (M/GDP) * \pi/(\pi + 1)$, where M is monetary base, GDP is nominal gross domestic product, and π is the annual inflation rate.

[8] If one includes the two stabilization plans announced on January 2, 1995, and March 9, 1995, as new Pacto phases, then there have been seventeen phases.

[9] See Schwartz (1994) for the dates of Pacto announcements and phase durations.

[10] The Mexican government's first stabilization plan, announced on January 2, 1995, allowed for a 7-percent increase in overall wages. On March 9, a revised plan included an additional 10-percent increase in the minimum wage, but those earning more than the minimum wage were free to negotiate their own wages.

[11] The overall fiscal balance referred to here is the public-sector borrowing requirement, which measures the difference between total revenue and expenditure, which includes debt amortization in the interest component. The primary balance, which excludes all of the interest component in expenditures, has been in surplus since 1985.

[12] See Michaely, Papageorgiou, and Choksi (1991) for an overview of the liberalization experience in several developing countries.

[13] This is a case analyzed by Staiger and Tabellini (1987). In formal economic terms, the government's objective is to redistribute income from individuals with a low marginal utility of income to those with a high marginal utility of income.

[14] Recent election results suggest such disenchantment. For the first time in its sixty-five year history, the ruling Institutional Revolutionary Party (PRI) lost the governorship in the state of Jalisco, which includes Mexico's second largest city, Guadalajara. The victory went to the National Action Party (PAN), which received 55 percent of the vote.

[15] See Gould and Ruffin (forthcoming).

[16] See Gould (1992) for a more in-depth discussion of this topic.

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Energy Prices and State Economic Performance

Stephen P.A. Brown
Assistant Vice President and Senior Economist
Federal Reserve Bank of Dallas

Mine K. Yücel
Senior Economist and Policy Advisor
Federal Reserve Bank of Dallas

In this article, we use simulations based on input–output analysis to examine how declines in the prominence of the industries most sensitive to oil prices have affected and are likely to affect the response of state economies to changes in oil prices.

Over the past two decades, interregional divisiveness has been an integral part of the debate over U.S. energy policy. Energy-producing regions have tended to favor policies that would boost domestic energy prices, while energy-consuming regions have tended to favor policies that would lower domestic energy prices.

In fact, fluctuations in energy prices have been frequently cited as a major reason for differences in regional economic performance during the late 1970s and early 1980s. Rising oil prices stimulated economic growth in energy-exporting states and retarded economic growth in energy-importing states. Falling oil prices retarded economic growth in energy-exporting states and stimulated economic growth in energy-importing states.

In the past decade, however, economic fluctuations have become increasingly correlated across states, and fluctuating energy prices have played a smaller role in the differences in economic performance across states (Sherwood-Call 1988). Increased homogeneity in the composition of state economies likely accounts for much of the increasing similarity in economic fluctuations across regions (Barro and Sala-I-Martin 1991, Carlino and Mills 1993). By our estimates, however, shrinkage of the industries most sensitive to energy prices has also contributed to the declining role of energy price fluctuations in the differences in economic performance across states. This trend is likely to continue throughout the 1990s.

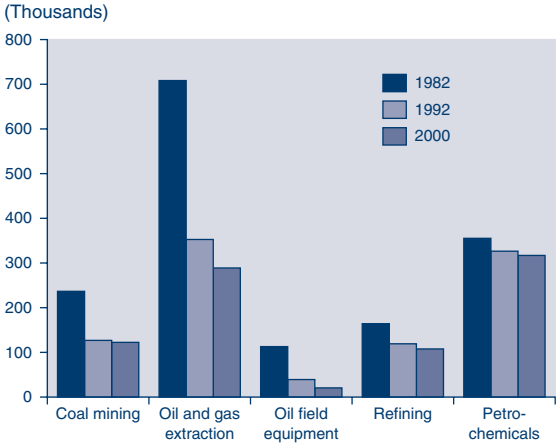
In this article, we use simulations based on input–output analysis to examine how declines in the prominence of the industries most sensitive to oil prices have affected and are likely to affect the response of state economies to changes in oil prices. We find that the decreased prominence of these industries in nearly every state's economy has reduced the differences in the states' responses to changes in oil prices. Given forecasts that the industries most sensitive to oil prices will further decline in prominence during the 1990s, we expect the differences in the states' responses to oil price changes to decline further throughout the decade.

These findings have important implications for economic activity and national energy policy. The role of energy price fluctuations in the variation in economic activity across states should continue to diminish, as it has done in the past decade. In addition, the regional flavor of national debates over energy policy should diminish.

Diversification of state economies

Since 1982, state economies have diversified away from both energy-intensive industries

Figure 1
U.S. Energy-Related Employment



SOURCES: Bureau of Labor Statistics, U.S. Department of Labor; U.S. Department of Energy.

and energy-producing industries. Projections made by the U.S. Department of Energy (DOE) and DRI/McGraw–Hill (DRI) indicate this trend will continue through 2000, albeit at a slower rate.

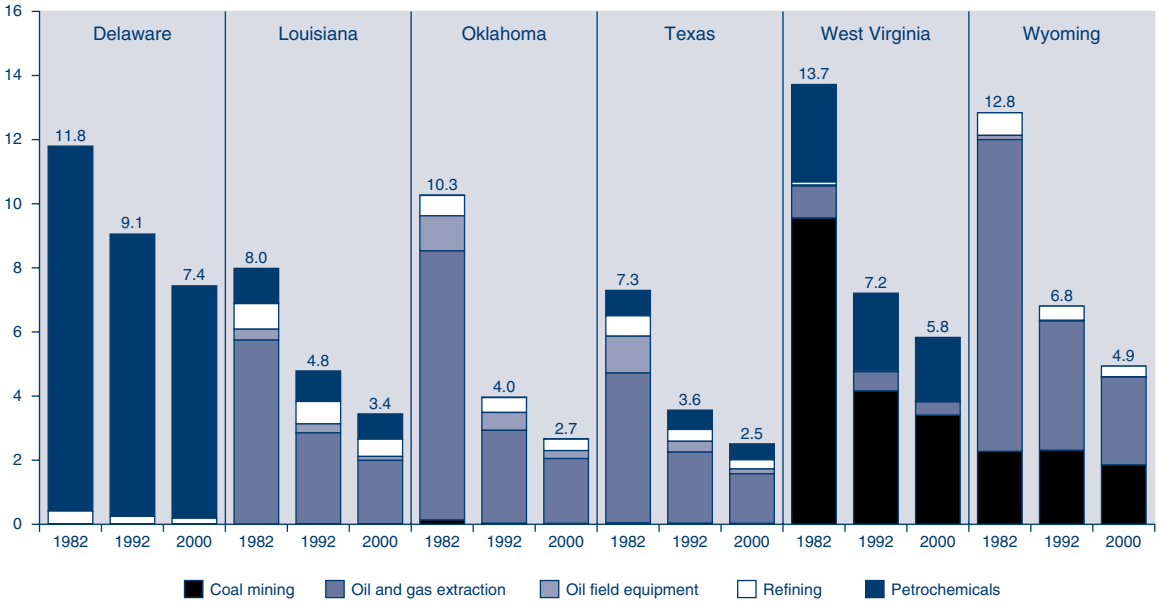
A shrinking energy industry. In 1982, the five industries most sensitive to oil prices—coal mining, oil and gas extraction, oil field machinery, petroleum refining, and petrochemicals—accounted for 1.6 million jobs (1.8 percent of total U.S. nonagricultural employment). Of these five key energy industries, oil and gas extraction accounted for the largest share of total nonagricultural employment at 0.79 percent (*Figure 1*), followed by petrochemicals with an employment share of 0.40 percent and coal mining with a 0.26 percent share. Refining accounted for 0.18 percent employment, and oil field machinery accounted for 0.13 percent.

The decade from 1982 to 1992 brought wild swings in oil prices and a severe downsizing in the oil and gas industry. Oil prices were at an all-time high in the first quarter of 1981 at $36 per barrel. They remained relatively high in 1982 but began a slow decline that continued until July 1986, when they collapsed to $11 per barrel.

Lower oil prices brought about a drastic downsizing in oil and gas extraction and related service industries. Coal prices also fell, and coal mining was reduced. Falling consumption of refined products and petrochemicals—a lagged response to the higher prices in the late 1970s and early 1980s—also led to a decline of the refining and petrochemical industries.

From 1982 to 1992, employment in the five key energy industries declined a total of 39 percent, while total U.S. nonagricultural employment increased by 23 percent. By 1992, the five industries accounted for only 1 million jobs (0.9 percent of total U.S. nonagricultural employment). Oil and gas extraction accounted for 0.32 percent of total nonagricultural employment. Petrochemicals claimed an employment share of 0.30 percent, coal mining 0.12 percent, refining 0.11 percent, and oil field machinery 0.04 percent.

Figure 2
Energy-Related Employment for Select States



SOURCES: Bureau of Labor Statistics, U.S. Department of Labor; U.S. Department of Energy; Independent Petroleum Association of America.

The DOE/DRI projections suggest an employment decline of 11 percent in the five key energy industries between 1992 and 2000, while total U.S. nonagricultural employment increases by 15 percent. In oil and gas extraction, resource depletion and productivity gains are projected to reduce employment. In oil field machinery, productivity gains and a declining domestic market are projected to lead to reduced employment. In coal, refining, and petrochemicals, productivity gains and growth slower than that of the national economy are projected to translate into slight employment losses from 1992 to 2000.

By 2000, the five key energy industries are projected to account for 0.9 million jobs (0.7 percent of total U.S. nonagricultural employment). Oil and gas extraction is projected to account for 0.23 percent of total nonagricultural employment, petrochemicals 0.25 percent, coal mining 0.10 percent, refining 0.09 percent, and oil field machinery 0.02 percent.

Increasing diversification of state economies. At the same time that energy industries have been shrinking, individual state economies have increasingly diversified away from energy-intensive and energy-producing industries. Since the early 1980s, nearly every state has become less dependent on the five key energy industries. This trend is likely to continue throughout the remainder of the 1990s.

For example, in 1982 the five key energy industries accounted for 7.3 percent to 13.7 percent of nonagricultural employment in the six states with the highest concentrations of energy-industry employment—Delaware, Louisiana, Oklahoma, Texas, West Virginia, and Wyoming (*Figure 2*). By 1992, the same five industries accounted for 3.6 percent to 9.1 percent of nonagricultural employment in the six states. The most dramatic effects occurred in the oil- and gas-producing states. By 1992, the combined employment shares of oil and gas extraction and oil field machinery in Louisiana, Oklahoma, Texas, and Wyoming were less than 50 percent of the 1982 levels. Data for all 50 states and the District of Columbia indicate that declines in the size of the energy industry reduced the variance of employment in the five key energy industries across the states from 1982 to 1992 (*Table 1*).[1]

From 1992 to 2000, the energy industry is likely to continue to lose prominence in individual state economies, but less dramatically than during the 1980s. Our reading of the DOE/DRI projections indicates that the five industries will account for 2.5 percent to 7.4 percent of nonagricultural employment in the six states with the highest concentrations of energy-industry employment. Continued declines in the size of the energy industry will further reduce the variance of employment in the five key energy industries across states from 1992 to 2000.

Table 1
Employment-Weighted Variances In Energy-Industry Employment Across States

	Coal mining	Oil and gas extraction	Oil field machinery	Refining	Petro-chemicals	Sum energy
1982	.8646	2.9653	.0973	.0390	.5302	6.6927
1992	.1548	.5405	.0110	.0180	.3188	1.6354
2000	.1091	.2700	.0022	.0111	.2250	.9251

Employment-Weighted Coefficients of Variation In Energy-Industry Employment Across States

	Coal mining	Oil and gas extraction	Oil field machinery	Refining	Petro-chemicals	Sum energy
1982	354.10	221.25	247.97	108.43	184.79	148.44
1992	346.89	227.02	272.62	122.86	191.13	145.27
2000	343.28	222.82	267.90	121.52	188.06	140.19

Analytical framework

To analyze how the composition of each state's economy affects its response to changing oil prices, we use a computational model developed by Brown and Hill (1988). In this model, differences in state concentrations of energy-producing and energy-consuming industries are the principal factors accounting for the variation across states of the employment response to changing oil prices. The model also allows for differences in multiplier effects across states while remaining computationally tractable.

In this framework, employment in each state is decomposed into two parts. One part captures the abundance or scarcity of key energy-producing and energy-consuming industries in the state relative to the nation. The other part, which contains both key and non-key industries, has the same composition of employment as the national economy.[2] For the former part, the effects of changing oil prices are modeled as a combination of the direct effects on key industries and indirect multiplier effects. For the latter part, the effect of changing oil prices is modeled as identical to those occurring at the national level. The total effect of changing oil prices on state employment is the sum of the effects on the two parts.

In the model, let E^*_{ij} denote the margin by which employment in industry i is overrepresented (+) or underrepresented (–) in state j. Estimates of the E^*_{ij} are developed by hypothetically withdrawing workers from, or adding workers to, a set of key energy-producing and

energy-consuming industries—and the non-key workers they support through multiplier effects—until the remaining industry composition of each state is identical to that of the nation. Formally, E^*_{ij} is represented by the expression

$$E^*_{ij} = E_{ij} - s_i \bullet (N_j - N^*_j) \quad (1)$$

for every key industry i. In equation 1, E_{ij} represents actual employment in key industry i for state j, N_j actual state employment in non-key industries, s_i the ratio of national employment in industry i to national employment in non-key industries, and N^*_j the employment in non-key industries in state j that can be attributed to multiplier effects associated with the overrepresentation or underrepresentation of the key industries, E^*_{ij}.

Formally, N^*_j can be expressed as

$$N^*_j = \sum m_{ij} E^*_{ij}, \quad (2)$$

where summation is over i, and m_{ij} is the multiplier effect from key industry i into the non-key industries but not other key industries. The m_{ij} accounts for the intermediate demands that each key industry makes on the non-key industries and the indirect effects operating through personal income.

With some manipulation, equations 1 and 2 can be combined to obtain a computable expression for the E^*_{ij} as follows:

$$E^*_{ij} = E_{ij} - s_i \bullet N_j \frac{1 - \sum m_{ij} \frac{E_{ij}}{N_j}}{1 - \sum m_{ij} s_i}. \quad (3)$$

By construction, all the E^*_{ij} are zero if $E_{ij}/N_j = s_i$ for all i in state j. Such a case would arise if employment in the key industries represented the same proportions in the state as the nation. Otherwise, the E^*_{ij} will tend to be positive when $E_{ij}/N_j > s_i$ and negative when $E_{ij}/N_j < s_i$.

Once the nonrepresentative portions of the state economy are defined, the remaining state employment, T^*_j, is identical in composition to the national economy at some degree of aggregation:

$$T^*_j = N_j - N^*_j + \sum \left(E_{ij} - E^*_{ij} \right). \quad (4)$$

With each state's economy divided into two parts, the total response of each state's employment to a change in oil prices, ΔT_j, can be represented as a combination of the national response, the responses of key industries, and multiplier effects as follows:

$$\Delta T_j = T^*_j \frac{\Delta T}{T} + \sum E^*_{ij} \left(1 + m_{ij}\right) \frac{\Delta E_i}{E_i}, \quad (5)$$

where summation is over i, $\Delta T/T$ represents the percentage change in total national employment resulting from a change in oil prices, and $\Delta E_i/E_i$ the percentage change in national employment in key industry i resulting from a change in oil prices.

Data and parameter values

Key industries. Although the procedure allows the use of any number of key industries, we follow Brown and Hill and limit the key industries to five. These include oil and gas extraction (Standard Industrial Classification code 13), coal extraction (code 12), oil field machinery (code 3533), petroleum refining (code 2911), and petrochemicals (codes 282 and 286). Employment in the remaining, non-key industries is assumed to respond uniformly to a change in oil prices.

The list of key industries does not include a number of industries that are directly affected by changing oil prices. Some of those ignored—such as pulp and paper; stone, clay, and glass; food processing; primary metals; electric utilities; and transportation—are important energy-using industries. Nevertheless, the list of key industries should be sufficiently complete to provide a good estimate of the effects that changing oil prices have on state employment. Empirically, the omitted industries are substantially less sensitive to oil prices than the included industries. In addition, many of the omitted industries are distributed more evenly across the states than are the key industries.

Employment data. We use the employment and earnings series produced by the Bureau of Labor Statistics, U.S. Department of Labor, as the basic data source for 1982 and 1992. Where this series lacks sufficient detail for the analysis, we supplement it with the annual employment and wages series produced by the Bureau of Labor Statistics and data obtained from the Independent Petroleum Association of America.

Employment data for 2000 are based on a DOE/DRI forecast.[3] We chose the DOE/DRI forecast because it provides sufficient detail for our analysis, is generally consistent with the consensus outlook for energy markets, and is often taken as a standard reference for analysis. The forecast shows U.S. employment increasing by almost 15 percent from 1992 to 2000, while employment in the key industries declines.

We follow the DOE forecast and allow for differences in employment growth across the

nine U.S. census regions (as shown in *Table 2*).[4] The DOE projects that three regions—Mountain, South Atlantic, and West South Central—will grow more rapidly than the nation between 1992 and 2000. For the same time period, the DOE also projects, the Pacific region will grow at the same rate as the nation, and five regions—West North Central, East South Central, East North Central, New England, and Mid-Atlantic, will grow more slowly than the nation.

Table 2
Projected Employment Growth by Census Region, 1992–2000
(Percent)

United States	14.64
New England (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont)	10.08
Mid-Atlantic (New Jersey, New York, Pennsylvania)	10.08
East North Central (Illinois, Indiana, Michigan, Ohio, Wisconsin)	10.98
West North Central (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota)	14.33
South Atlantic (Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia)	17.96
East South Central (Alabama, Kentucky, Mississippi, Tennessee)	11.14
West South Central (Arkansas, Louisiana, Oklahoma, Texas)	17.32
Mountain (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming)	20.44
Pacific (Alaska, California, Hawaii, Oregon, Washington)	14.64

SOURCE: U.S. Department of Energy.

Response of key industries

Brown and Hill estimated the long-run oil-price elasticities of employment in each key industry. They found elasticities of +1.01 for oil and gas extraction, +1.23 for oil field machinery, +0.45 for coal extraction, –0.56 for petroleum refining, and –0.32 for petrochemicals. We use these estimates to calculate the effects of changing oil prices on employment in the key industries nationwide.

Employment multipliers. The multipliers used in evaluating the employment effects are non-standard. The multiplier for each key industry expresses the effect of a unit change in employment in the key industry on state employment in non-key industries while holding the output of other key industries constant. These multipliers allow us to treat the output from each of the key industries as exogenous while avoiding a double-counting of purchases that key industries make from each other.

We adapted the work of Brown and Hill to develop the requisite employment multipliers for each of the five key industries in each state (and the District of Columbia) for each of the three analysis years.[5] They used a special inversion of a 1979 Texas input–output table to obtain special private output multipliers as described in Appendix A. They converted these multipliers to special private employment multipliers for Texas by using the associated employment coefficients.

Following Brown and Hill, we develop total special employment multipliers for each state and the District of Columbia for each of the analysis years by adjusting the special private employment multipliers Brown and Hill developed for Texas. To do so, we use information on 1982 state input–output multipliers supplied by the Bureau of Economic Analysis (BEA) (1986) and employment in state and local government as follows:[6]

$$(6) \qquad m_{ij} = \left((M_i - 1)\left(\frac{r_{ij}}{r_{itx}}\right) + 1 \right) \frac{1}{1 - g_j} - 1,$$

where m_{ij} is the multiplier effect from key industry i into the non-key industries but not other key industries in state j, M_i is the special private employment multiplier for Texas, r_{ij} is the BEA's private employment multiplier for industry i in state j, r_{itx} is the BEA's private employment multiplier for industry i in Texas, and g_j is the share of total employment in state j accounted for by state and local government in the analysis year.

National employment response. Brown and Hill surveyed the major forecasting services to obtain a consensus estimate of the response of national employment to changing energy prices. They concluded that a drop in the price of oil from $26.50 to $21.50 per barrel would increase national employment by 0.4 percent. They implemented this relationship through a point elasticity between oil prices and national employment equal to –0.0193.

We adopt Brown and Hill's estimate of the oil price elasticity of national employment for 1982. Since that year, however, both energy prices and the energy-to-GDP ratio have declined. The likely consequence is that the U.S. economy has become somewhat less sensitive to changes in energy prices. Although we are unaware of any formal research that shows how

the oil price sensitivity of the U.S. economy may have varied over time, discussions with a number of experts supports the view that U.S. economy has become less sensitive to oil price changes.

In the absence of formal estimates, we use a CES production function with parameter values drawn from the economics literature and information about energy prices and the energy-to-GDP ratio to calculate oil price elasticities of national employment for 1992 and 2000. We calibrated the function to reproduce the Brown–Hill estimate for 1982. We then input new prices and energy-to-GDP ratios to obtain estimates for 1992 and 2000. For 1992, we estimate the oil price elasticity of national employment to equal –0.0125. For 2000, the DOE/DRI forecast we have adopted yields an estimated oil price elasticity of national employment equal to –0.0120.[7]

Using the elasticities described above, we estimate that a permanent 10-percent increase in real oil prices would have resulted in a nationwide net employment loss of 165,000 jobs (0.18 percent) in 1982 and 129,000 jobs (0.12 percent) in 1992. In 2000, a permanent 10-percent increase in real oil prices is projected to result in a nationwide net employment loss of 142,000 jobs (0.11 percent).[8]

Table 3
Estimated Effects of a 10-Percent Increase in Oil Prices On 1982 Nonagricultural Employment
(Percent)

United States	–.18		
Delaware	–2.51	South Dakota	–.38
South Carolina	–.85	Connecticut	–.38
New Jersey	–.73	Arizona	–.38
Tennessee	–.67	Ohio	–.37
North Carolina	–.61	Maine	–.36
Missouri	–.53	Alabama	–.35
Virginia	–.50	Maryland	–.34
New Hampshire	–.49	Nevada	–.33
Hawaii	–.47	California	–.33
Massachusetts	–.45	Nebraska	–.32
New York	–.44	District of Columbia	–.31
Pennsylvania	–.43	Arkansas	–.23
Minnesota	–.43	Kentucky	–.07
Washington	–.43	Utah	.02
Wisconsin	–.42	Mississippi	.03
Iowa	–.42	Kansas	.16
Indiana	–.42	North Dakota	.30
Oregon	–.42	West Virginia	.31
Rhode Island	–.42	Montana	.32
Illinois	–.41	Colorado	.44
Michigan	–.40	Alaska	.56
Florida	–.39	New Mexico	.83
Idaho	–.39	Louisiana	1.35
Georgia	–.39	Texas	1.37
Vermont	–.39	Oklahoma	2.91
		Wyoming	3.03

Oil prices shocks and state employment

We use the model and parameters described above to assess how diversification away from the key energy industries has and will affect each state's response to a change in oil prices. To do so, we simulate the employment consequences of a hypothetical 10-percent increase in oil prices in each of three years: 1982, 1992, and 2000.[9] Our simulations show that since 1982 the variance across states in the response of economic activity to oil price changes has declined. Our simulations further show that the narrowing is likely to continue through the end of the decade but at a slower rate.

State employment effects, 1982. In 1982, oil prices were $48.40 per barrel (in 1992 dollars). In that year, a 10-percent increase in the price of oil would have amounted to $4.84 per barrel. Such an increase would have led to employment losses of 165,000 nationwide (0.18 percent). Nonetheless, thirteen states would have gained employment for a combined total of 166,000 jobs (*Table 3*). The remaining thirty-seven states and the District of Columbia would have lost a combined employment of 331,000 jobs.

The estimated effects of higher oil prices vary considerably for 1982. The states most adversely affected by higher oil prices have high concentrations of employment in refining or petrochemicals (industries hurt by rising oil prices) and low concentrations of employment in coal, oil and gas extraction, and oil field machinery (industries helped by rising oil prices). The states helped by rising oil prices have high concentrations of employment in oil and gas extraction and oil field machinery. Many of these states also have relatively high concentrations of refining and petrochemicals, which partially offset the effects operating through the oil and gas extraction sector.

Coal mining is less important in driving the estimates because coal is not as sensitive to oil price changes as oil and gas extraction or oil field machinery and has smaller multipliers than refining or petrochemicals. Nonetheless, the extremely high concentrations of coal mining lead to estimated employment gains in West Virginia. Relatively high concentrations of coal mining also contribute to estimated employment gains in Wyoming.

States between the extremes tend to have more balanced concentrations of all industries. Those states in which the five key industries have smaller shares than the national average but appear in the same proportions to each other as they do in the nation are hurt more by rising oil prices than the nation as a whole. Conversely, those states in which the five key industries have larger shares than the national average but appear in the same proportions to each other as they do in the nation are hurt less by rising oil prices than the nation as a whole.

State employment effects, 1992. In 1992, oil prices were $18.20 per barrel (in 1992 dollars). In that year, a 10-percent increase in the price of oil would have amounted to $1.82 per barrel. Such an increase would have led to employment losses of 129,000 nationwide (0.12 percent). Nine states would have gained 68,000 jobs (*Table 4*).[10] The remaining forty-one states and the District of Columbia would have lost a combined employment of 197,000 jobs.

By 1992, Montana, Utah, Mississippi, and West Virginia would no longer have gained employment from higher oil prices. Between 1982 and 1992, employment in coal mining, oil and gas extraction, and oil field machinery declined enough in these states such that the prospective gains in these industries resulting from higher oil prices could no longer offset the losses in other sectors of the states' economies.

A comparison of estimates for 1982 and 1992 indicates that states became increasingly similar in the response to a change in oil prices. At the extremes, 10-percent higher oil prices would have reduced employment by 2.51 percent in Delaware and increased employment by 2.91 percent in Oklahoma and 3.03 percent in Wyoming in 1982. In 1992, the same increase would have yielded extremes of –1.86 percent in Delaware, 0.95 percent in Oklahoma, and 1.40 percent in Wyoming. We find the employment-weighted variance of the response across states to be 0.4598 in 1982 and 0.0749 in 1992.[11]

Alaska is one state that countered the pattern of convergence. Higher oil prices would have meant a 0.56-percent increase in employment during 1982 and a 0.66-percent increase in 1992. With new finds in Alaska in the 1980s, Alaskan oil production peaked in 1988, and the oil industry continued to thrive in the 1980s despite lower oil prices.

State employment effects, 2000. For 2000, DOE projects oil prices will be $20.70 per barrel (in 1992 dollars). In 2000, a 10-percent increase in the price of oil would amount to $2.07 per barrel. Such an increase would lead to employment losses of 142,000 nationwide (0.11 percent). Eight states would gain 46,000 jobs (*Table 5*).[12] The remaining forty-two states and the District of Columbia would lose a combined employment of 197,000 jobs.

The pattern of diminished oil price effects and variance across states is repeated in 2000. In 1992, 10-percent higher oil prices would have reduced employment by 1.86 percent in Delaware and increased employment by 0.95 percent in Oklahoma and 1.40 percent in Wyoming. By 2000, the same increase is projected to yield extremes of –1.54 percent in Delaware, 0.58 percent in Oklahoma, and 0.94 percent in Wyoming. We find the employment-weighted variance of the response across states to be 0.0749 in 1992 and 0.0360 in 2000.[13]

Converging state employment effects, 1982 to 2000. Although the variance in the response to oil prices across states is projected to diminish from 1992 and 2000, the rate of convergence is less than that from 1982 to 1992. In 1982, oil prices were near record highs and the domestic oil and gas industry was at its peak. In the early 1980s, the energy-consuming states diversified away from energy-intensive industries and

Table 4
Estimated Effects of a 10-Percent Increase in Oil Prices On 1992 Nonagricultural Employment
(Percent)

United States	–.12		
Delaware	–1.86	Florida	–.16
South Carolina	–.47	Oregon	–.16
Tennessee	–.37	Idaho	–.15
New Jersey	–.36	Nevada	–.15
North Carolina	–.28	Alabama	–.14
Virginia	–.24	Wisconsin	–.14
Pennsylvania	–.22	Arizona	–.14
Illinois	–.22	South Dakota	–.14
Ohio	–.22	Maine	–.13
Missouri	–.22	Maryland	–.12
Hawaii	–.22	Kentucky	–.12
Minnesota	–.21	Nebraska	–.11
Rhode Island	–.21	Mississippi	–.10
New Hampshire	–.19	Montana	–.06
Indiana	–.19	West Virginia	–.06
Massachusetts	–.19	Arkansas	–.05
Michigan	–.19	Utah	–.05
New York	–.18	Kansas	.03
Washington	–.18	Colorado	.09
Connecticut	–.17	North Dakota	.14
Vermont	–.17	New Mexico	.44
Georgia	–.16	Louisiana	.53
California	–.16	Texas	.53
Iowa	–.16	Alaska	.72
District of Columbia	–.16	Oklahoma	.95
		Wyoming	1.40

Table 5
Estimated Effects of a 10-Percent Increase in Oil Prices On 2000 Nonagricultural Employment
(Percent)

United States	–.11		
Delaware	–1.54	Florida	–.13
South Carolina	–.39	Nevada	–.13
New Jersey	–.32	Oregon	–.12
Tennessee	–.31	Idaho	–.12
North Carolina	–.23	Alabama	–.12
Virginia	–.20	Wisconsin	–.12
Pennsylvania	–.19	Arizona	–.11
Ohio	–.19	South Dakota	–.11
Illinois	–.19	Maryland	–.10
Missouri	–.18	Maine	–.10
Hawaii	–.18	Mississippi	–.10
Rhode Island	–.17	Kentucky	–.09
Minnesota	–.17	Nebraska	–.09
Michigan	–.16	West Virginia	–.08
Massachusetts	–.16	Montana	–.07
Indiana	–.16	Arkansas	–.06
New Hampshire	–.16	Utah	–.06
New York	–.16	Kansas	–.00
Washington	–.16	Colorado	.04
Connecticut	–.15	North Dakota	.08
California	–.14	New Mexico	.27
Vermont	–.14	Louisiana	.28
District of Columbia	–.14	Texas	.30
Georgia	–.13	Alaska	.49
Iowa	–.13	Oklahoma	.58
		Wyoming	.94

learned to conserve. As consumption fell, oil prices slipped and then crashed. Falling oil prices encouraged the energy-producing states to diversify away from energy industries. By 1992, the variance across states in response to changing oil prices had narrowed substantially.

For the 1990s, DOE projects less dramatic price changes than occurred in the 1980s. The implied impetus for diversification away from energy-related industries is thus weaker. It follows that the projected convergence will be less in the 1990s than it was in the 1980s.

Summary and conclusions

Changes in energy prices have had sizable but different effects on economic activity across states. The industrial composition of a state's economy determines the employment response to a change in energy prices. Our simulations show that as the states diversify away from energy-intensive and energy-producing industries, the variation across states in the response of economic activity to oil price changes is lessening.

During the 1980s, volatile oil prices helped erode the prominence of energy-intensive and energy-producing industries in nearly every state's economy. The consequence was reduced sensitivity to oil price changes and less variation across states in the response to changing oil prices. Without further impetus from volatile oil prices, industries sensitive to oil prices are likely to become only slightly less prominent during the remainder of the 1990s. Therefore, the rate at which states are becoming similar in their response to oil price changes is likely to moderate.

Nonetheless, the variance of energy-sensitive industries across states is projected to continue falling in the 1990s. This continuing convergence is likely to further reduce the differences in states' response to changing energy prices. In doing so, it could also further lessen the interregional divisiveness that has characterized past debate on national energy policy.

Notes

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[1] For all but one of the industries, the decline in variance is a size effect. Only the data for coal mining show a decline in the coefficient of variation from 1982 to 1992. Of these measures, variance more closely represents the range of influence across states.

[2] The composition of the state's economy is identical to that of the nation at a degree of aggregation that is inversely related to the number of key industries.

[3] See Energy Information Administration (1994a and 1994b) and DRI/McGraw–Hill (1994).

[4] See Energy Information Administration (1994b).

[5] Multiplier effects arise because industries purchase inputs from one another and consumers use their income to purchase goods and services. States with less diverse economies generally have lower multiplier effects because subsequent purchases quickly leak out to other states. Use of state-specific multipliers accounts for the differences in leakages across states but does not account for the corresponding injections that the exporting states enjoy. The exporting states are likely to be substantially larger than the nondiverse states; therefore, a total accounting may not be crucial to the analysis.

[6] A 1986 input–output table is available for Texas. We use a 1979 input–output table for Texas because it is most consistent with the 1982 input–output multipliers provided by the BEA.

[7] Because this procedure to estimate elasticities is ad hoc, we also consider cases in which the oil price elasticity of U.S. employment remains constant at –0.0193. We find that the assumed value of the national elasticity affects the level of each state's

response to oil prices but does not substantially alter the variance across states. See Appendix B.

[8] Under the assumption that the oil price elasticity of U.S. employment is maintained at –0.0193 for 1992 and 2000, we estimate a 10-percent increase in real oil prices would have resulted in a nationwide employment loss of 200,000 jobs in 1992 and would result in a nationwide employment loss of 228,000 jobs in 2000.

[9] Because the model operates on constant price elasticities, a constant percentage increase in prices maintains comparability across years.

[10] Only eight states would benefit from higher oil prices if we assume that the national economy remained as sensitive to oil prices in 1992 as it was in 1982. See Appendix B.

[11] The variation across states is not simply a size effect. The coefficients of variation for 1982 and 1992 are –378.04 and –241.95, respectively.

[12] Only seven states would benefit from higher oil prices if we assume that the national economy remains as sensitive to oil prices in 2000 as it was in 1982. See Appendix B.

[13] The coefficients of variation are –241.95 for 1992 and –172.27 for 2000.

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Appendix A

Developing Special Output Multipliers

The analysis presented in the body of the article requires special output multipliers. Each special multiplier represents the effect of a unit change in the output of a key energy industry on the output in non-key industries while holding the output of other key energy industries constant. These multipliers allow us to treat the output from each of the key industries as exogenous while avoiding the double-counting of purchases that key industries make from each other.

Each industry i must produce enough output to satisfy both final demand and meet the input requirements of all industries as follows:

$$x_i = d_i + \sum_{j=1}^{n} a_{ij}x_j \qquad i = 1,2,\ldots,n. \tag{A.1}$$

In the above equation, x_i is the output of industry i, d_i is the final demand for goods produced in industry i, a_{ij} indicates how much of industry i's output is used to produce each unit of industry j's output, and n is the number of industries.

If we treat the first g industries as the key energy industries for which output is exogenous, the equations described in A.1 can be divided into two groups by placing all endogenous variables on the left-hand side and all exogenous variables on the right-hand side of each equation as follows:

$$-d_i - \sum_{j=g+1}^{n} a_{ij}x_j = x_i + \sum_{j=1}^{g} a_{ij}x_j \qquad i = 1,2,\ldots,g, \text{ and} \tag{A.2}$$

$$x_i - \sum_{j=g+1}^{n} a_{ij}x_j = d_i + \sum_{j=1}^{g} a_{ij}x_j \qquad i = g+1,\ldots,n. \tag{A.3}$$

In matrix notation, equations A.2 and A.3 are rewritten as

$$-\boldsymbol{D}_g - \boldsymbol{A}_{g,n-g}\boldsymbol{X}_{n-g} = -\left[\boldsymbol{I}_g - \boldsymbol{A}_g\right]\boldsymbol{X}_g, \text{ and} \tag{A.4}$$

$$\left[\boldsymbol{I}_{n-g} - \boldsymbol{A}_{n-g}\right]\boldsymbol{X}_{n-g} = \boldsymbol{D}_{n-g} + \boldsymbol{A}_{n-g,g}\boldsymbol{X}_g. \tag{A.5}$$

In the above equations, $\boldsymbol{D}_g$ and $\boldsymbol{D}_{n-g}$ are vectors of the final demands for output from the key energy industries and non-key industries respectively, $\boldsymbol{A}_{g,n-g}$ and $\boldsymbol{A}_{n-g}$ are arrays of input coefficients relating the outputs of the non-key industries to the inputs required from the key industries and the non-key industries, respectively, $\boldsymbol{X}_g$ and $\boldsymbol{X}_{n-g}$ are vectors of the output from the key and non-key industries, respectively, $\boldsymbol{I}_g$ and $\boldsymbol{I}_{n-g}$ are identity matrices, and $\boldsymbol{A}_g$ and $\boldsymbol{A}_{n-g,g}$ are arrays of input coefficients relating the output of key industries to the inputs required from the key industries and the non-key industries, respectively.

Combining A.4 and A.5 yields:

$$\begin{bmatrix} -\boldsymbol{I}_g & -\boldsymbol{A}_{g,n-g} \\ \boldsymbol{0}_{n-g,g} & \boldsymbol{I}_{n-g} - \boldsymbol{A}_{n-g} \end{bmatrix}\begin{bmatrix} \boldsymbol{D}_g \\ \boldsymbol{X}_{n-g} \end{bmatrix} = \begin{bmatrix} -\boldsymbol{I}_g + \boldsymbol{A}_g & \boldsymbol{0}_{g,n-g} \\ \boldsymbol{A}_{n-g,g} & \boldsymbol{I}_{n-g} \end{bmatrix}\begin{bmatrix} \boldsymbol{X}_g \\ \boldsymbol{D}_{n-g} \end{bmatrix}. \tag{A.6}$$

In the equation A.6, $\boldsymbol{0}_{n-g,g}$ and $\boldsymbol{0}_{g,n-g}$ are arrays of zeros.

Equation A.6 can be rewritten to express the endogenous variables as a function of the exogenous variables and the input coefficients as follows:

$$\begin{bmatrix} \boldsymbol{D}_g \\ \boldsymbol{X}_{n-g} \end{bmatrix} = \begin{bmatrix} -\boldsymbol{I}_g & -\boldsymbol{A}_{g,n-g} \\ \boldsymbol{0}_{n-g,g} & \boldsymbol{I}_{n-g} - \boldsymbol{A}_{n-g} \end{bmatrix}^{-1}\begin{bmatrix} -\boldsymbol{I}_g + \boldsymbol{A}_g & \boldsymbol{0}_{g,n-g} \\ \boldsymbol{A}_{n-g,g} & \boldsymbol{I}_{n-g} \end{bmatrix}\begin{bmatrix} \boldsymbol{X}_g \\ \boldsymbol{D}_{n-g} \end{bmatrix}. \tag{A.7}$$

An alternative approach is to recognize that equation A.5 shows the output vector of non-key industries, $\boldsymbol{X}_{n-g}$, strictly as a function of exogenous variables and parameters. Equation A.5 can be rewritten to express the output of the non-key industries as a function of the exogenous variables and the input coefficients as follows:

$$\boldsymbol{X}_{n-g} = \left[\boldsymbol{I}_{n-g} - \boldsymbol{A}_{n-g}\right]^{-1}\left[\boldsymbol{D}_{n-g} + \boldsymbol{A}_{n-g,g}\boldsymbol{X}_g\right]. \tag{A.8}$$

Combining equations A.8 and A.4 yields the following expression for the final demand for output from the key energy industries:

$$\boldsymbol{D}_g = \left[\boldsymbol{I}_g - \boldsymbol{A}_g\right]\boldsymbol{X}_g - \boldsymbol{A}_{g,n-g}\left[\left[\boldsymbol{I}_{n-g} - \boldsymbol{A}_{n-g}\right]^{-1}\left[\boldsymbol{D}_{n-g} + \boldsymbol{A}_{n-g,g}\boldsymbol{X}_g\right]\right]. \tag{A.9}$$

The special output multipliers associated with each key energy industry (i=1, 2,..., g) can be obtained from A.7 or A.8. Take total derivatives of either expression with respect to x_i and combine as follows:

$$M_i = 1 + \sum_{j=g+1}^{n} \partial x_j / \partial x_i \qquad i = 2,\ldots,g. \tag{A.10}$$

Throughout the analysis, g determines the number of key industries—those for which output is treated as exogenous. For all values of g, output multipliers for each of the key energy industries include purchases from non-key industries but exclude purchases from other key industries. For g=1, the procedures outlined above yield a standard output multiplier that includes purchases from all other industries.

Appendix B

Estimated Effects of Oil Price Increases with a Constant National Response

Tables B1 and B2 present alternate estimates of the effects of a 10-percent increase in oil prices for 1992 and 2000. These estimates are made under the assumption that the national employment response remains at the 1982 value of 0.18 percent.

Table B1

Estimated Effects of a 10-Percent Increase in Oil Prices On 1992 Nonagricultural Employment

(Percent)

United States	**–.18**				
Delaware	–1.89	New York	–.25	Maryland	–.19
South Carolina	–.53	Washington	–.25	Nebraska	–.18
Tennessee	–.43	Connecticut	–.24	Kentucky	–.18
New Jersey	–.43	Vermont	–.24	Mississippi	–.17
North Carolina	–.35	Georgia	–.23	Montana	–.12
Virginia	–.30	California	–.23	Arkansas	–.12
Pennsylvania	–.29	Iowa	–.23	Utah	–.12
Illinois	–.29	Oregon	–.22	West Virginia	–.11
Ohio	–.29	Florida	–.22	Kansas	–.04
Missouri	–.28	District of Columbia	–.22	Colorado	.02
Hawaii	–.28	Idaho	–.22	North Dakota	.07
Minnesota	–.28	Nevada	–.22	New Mexico	.38
Rhode Island	–.27	Wisconsin	–.21	Louisiana	.47
New Hampshire	–.26	Alabama	–.21	Texas	.48
Indiana	–.26	Arizona	–.21	Alaska	.66
Massachusetts	–.26	South Dakota	–.20	Oklahoma	.90
Michigan	–.25	Maine	–.20	Wyoming	1.34

Table B2

Estimated Effects of a 10-Percent Increase in Oil Prices On 2000 Nonagricultural Employment

(Percent)

United States	**–.18**				
Delaware	–1.57	Washington	–.23	Maryland	–.18
South Carolina	–.45	New York	–.23	Mississippi	–.17
New Jersey	–.39	Connecticut	–.22	Nebraska	–.17
Tennessee	–.38	California	–.21	Kentucky	–.16
North Carolina	–.30	Vermont	–.22	Montana	–.14
Virginia	–.26	District of Columbia	–.21	West Virginia	–.14
Pennsylvania	–.26	Georgia	–.21	Arkansas	–.13
Ohio	–.26	Iowa	–.20	Utah	–.13
Illinois	–.26	Florida	–.20	Kansas	–.07
Missouri	–.25	Nevada	–.20	Colorado	–.03
Hawaii	–.25	Oregon	–.20	North Dakota	.01
Rhode Island	–.24	Idaho	–.20	New Mexico	.20
Minnesota	–.24	Alabama	–.19	Louisiana	.22
Michigan	–.23	Wisconsin	–.19	Texas	.24
Massachusetts	–.23	Arizona	–.18	Alaska	.43
New Hampshire	–.23	South Dakota	–.18	Oklahoma	.52
Indiana	–.23	Maine	–.18	Wyoming	.88

Optimal Monetary Policy in an Economy with Sticky Nominal Wages

Evan F. Koenig
Research Officer
Federal Reserve Bank of Dallas

While there is a consensus that monetary policy must be conducted within a framework in which people are confident of a low long-run inflation rate, there is little agreement on how the Federal Reserve ought to allow prices to respond to shocks over the near term. This article shows that the optimal monetary policy rule has the Federal Reserve target a geometric weighted average of output and the price level.

More than thirty-five years ago, Milton Friedman initiated an intense "rules versus discretion" debate by calling for the Federal Reserve to maintain constant growth of the money supply (Friedman 1959). The focus of this early debate was on whether an active monetary policy or a passive monetary policy is more successful at stabilizing output. Over the years, the debate has continued, but its terms have shifted.

First, large swings in the velocities of the monetary aggregates have led many economists to turn away from Friedman's constant-money-growth prescription, toward policy rules that are more directly concerned with output and prices.

Second, in a very real sense the debate is no longer over "rules *versus* discretion" but "*which* rule?" It's now taken for granted that the monetary authority follows a rule of *some* kind—albeit a rule that may not be clearly articulated and that may shift in response to changes in the composition of the authority's councils or changes in policymakers' understanding of how the economy operates. The behaviors of private agents are conditioned on how they expect the monetary authority to react to future shocks to the economy (Lucas 1976). Consequently, future policy choices cannot be treated as exogenous.

Finally, there is increased recognition that in monetary affairs—as in so many other areas of life—expedient policies are rarely the best policies. Moreover, to obtain a socially optimal outcome today may require that policymakers find a way to convince the private sector that shortsighted policies will not be pursued in the future (Barro and Gordon 1983, Kydland and Prescott 1977). In particular, the experience of the 1970s has led to a consensus that the private sector must never be given grounds for doubting the Federal Reserve's commitment to long-run price stability.

While there is a consensus that monetary policy must be conducted within a framework in which people are confident of a low long-run inflation rate, there is little agreement on how the Federal Reserve ought to allow prices to respond to shocks over the near term. This article attempts to shed light on the short-run stabilization issue within the context of an economy subject to productivity shocks, with sticky nominal wages. The article shows that the optimal monetary policy rule in such an economy has the Federal Reserve target a geometric weighted average of output and the price level. In a realistic special case, the monetary authority should target nominal spending.

The analysis is subject to a number of limitations. The model economy is not subject to any disturbances other than aggregate productivity shocks. There is no attempt to explicitly model the adverse effects of inflation. Nor does the article model how the Federal Reserve would actually go about implementing alternative policy rules. In the real world, some rules may have fewer informational requirements than others or may imply less extreme movements in policy instruments. Implementation errors are likely to be smaller for such rules, enhancing their performance.

This article has implications that extend beyond the short-run stabilization issue. Thus, this article illustrates that real-business-cycle models may accurately describe the historical behavior of an economy and yet be a poor guide to policy. That a large fraction of the business cycle can be attributed to supply shocks may mean not that monetary policy is ineffective but that the Federal Reserve has been doing its job. More generally, neither monetary policy nor private contracts should be analyzed in isolation. Policies optimal under one system of private contracts may perform poorly under a different system. Conversely, the performance of a given system of private contracts may be sensitive to the policy rule adopted by the monetary authority.

A simple model of aggregate supply

This section analyzes output determination and optimal monetary policy in a competitive economy subject to aggregate productivity shocks.[1] Initially, all prices are assumed to be perfectly flexible, so that markets clear instantaneously from period to period. In such an economy, monetary policy is irrelevant to short-run output determination. The monetary authority is, therefore, free to focus exclusively on maintaining price stability. Next, the money wage rate is assumed to be set one period in advance, introducing the possibility that output may deviate from its market-clearing level in response to unexpected shifts in the production function. Since the money wage rate fails to react to supply shocks in this economy, the burden of doing so falls on the monetary authority. The optimal policy rule has the monetary authority target a geometric weighted average of output and the price level. Insofar as the monetary authority is successful in implementing the optimal rule, the real economy will behave as if the money wage rate is perfectly flexible.

Aggregate supply with flexible prices. Profit maximization implies that the representative competitive firm will hire labor up to the point where the marginal product of labor equals the real wage:

$$(1) \qquad MP_N = W/P,$$

where N denotes hours of work. Suppose, in particular, that output is produced according to the function

$$(2) \qquad Y = \Theta N^{1-\beta}/(1-\beta),$$

where Y is output, $0 < \beta < 1$ is a fixed parameter, and Θ is a random productivity shock. Equation 1 is then equivalent to

$$(1') \qquad \theta - \beta n = w - p,$$

where lowercase letters represent logarithms of their uppercase counterparts. The demand for labor is an increasing function of the productivity shock and a decreasing function of the real wage. For any given level of hours, a doubling of Θ doubles the marginal product of labor and, so, doubles the real wage.

Utility maximization implies that the representative household will supply labor up to the point where the marginal rate of substitution between leisure and consumption equals the real wage. Equivalently, each household will supply labor up to the point where minus the marginal rate of substitution between *labor* and consumption equals the real wage:

$$(3) \qquad -MRS_{N,C} = W/P.$$

If the representative household's utility function takes the form

$$U(C,N) = (C^{1-\alpha} - 1)/(1-\alpha) - N^{1+\lambda}/(1+\lambda),$$

where C is consumption and $\alpha > 0$ and $\lambda > 0$ are fixed parameters, then equation 3 is equivalent to

$$(3') \qquad \lambda n + \alpha c = w - p.$$

The supply of labor is increasing in the real wage and decreasing in consumption.

To close the model, take logarithms of equation 2:

$$(2') \qquad y = (1-\beta)n + \theta - \ln(1-\beta),$$

and assume that all output is consumed, so that y can be substituted for c in equation 3′.

The market-clearing values of output, the real wage, and labor are obtained by simul-

taneously solving equations 1′, 2′, and 3′:

$$(4) \qquad y^* = A\left[(1+\lambda)\theta - (\beta+\lambda)\ln(1-\beta)\right],$$

$$(5) \qquad (w-p)^* = A\left[(\alpha+\lambda)\theta - \alpha\beta\ln(1-\beta)\right],$$

and

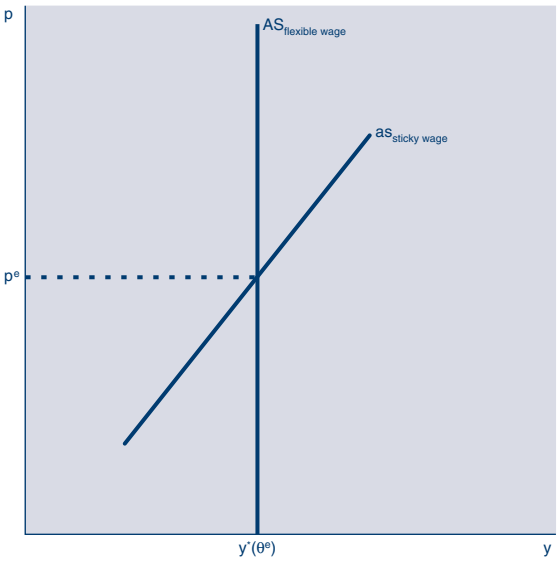
$$(6) \qquad n^* = A\left[(1-\alpha)\theta + \alpha\ln(1-\beta)\right],$$

where $A \equiv [\alpha + \beta(1-\alpha) + \lambda]^{-1}$. Equations 4 and 5 say that a positive productivity shock (an increase in θ) raises equilibrium output and the equilibrium real wage. The impact on equilibrium hours of work is ambiguous. The higher real wage that accompanies an increase in productivity tends to increase the supply of labor. This substitution effect is opposed, however, by a negative wealth effect: as output becomes more readily available, people are less willing to work at any given wage. In the real world, hours of work per person have changed relatively little despite large productivity gains. This observation suggests that $\alpha \approx 1$. If $\alpha = 1$, the substitution and wealth effects of an increase in productivity cancel. Equilibrium output and the equilibrium real wage rise one-for-one with θ, while equilibrium hours are constant.

Regardless of the value of α, in a market-clearing economy the evolution of output is independent of the evolution of the price level.

Figure 1
Aggregate Supply in Sticky-Wage and Flexible-Wage Economies

The aggregate supply curve is vertical when the money wage is flexible and upward sloping when the money wage is predetermined.



Since there is no short-run trade-off between output stability and price stability, the monetary authority can concentrate its efforts on achieving the latter.

Aggregate supply with a predetermined money wage. Predetermined nominal wages are an oft-studied source of monetary nonneutrality.[2] Moreover, the existence of meaningful nominal wage rigidities is consistent with several recent empirical studies (Card 1990, Cho 1993, Cho and Cooley 1992, McLaughlin 1994). Accordingly, the remainder of this article assumes that the money wage rate is set, one period in advance, at its expected market-clearing level and that firms have discretionary control over hours of work at the preset wage.[3] From equation 5, the money wage will equal

$$(7) \qquad w = p^e + A\left[(\alpha+\lambda)\theta^e - \alpha\beta\ln(1-\beta)\right],$$

where an e superscript indicates an expected value conditioned on information available in the immediately preceding period.

With the money wage set as above, the representative firm's profit maximization condition (equation 1′) implies that hours of work are given by

$$(8) \qquad n = n^* + \frac{1}{\beta}\left[\left(p - p^e\right) + \left(\alpha+\lambda\right)A\left(\theta - \theta^e\right)\right].$$

Substituting into the production function (equation 2′), one obtains a formula for output:

$$(9) \quad y = y^* + \left[\frac{1-\beta}{\beta}\right]\left[\left(p - p^e\right) + \left(\alpha+\lambda\right)A\left(\theta - \theta^e\right)\right].$$

Output and employment deviate from their market-clearing levels to the extent that the output price or productivity deviates from values expected at the time the wage rate was set.

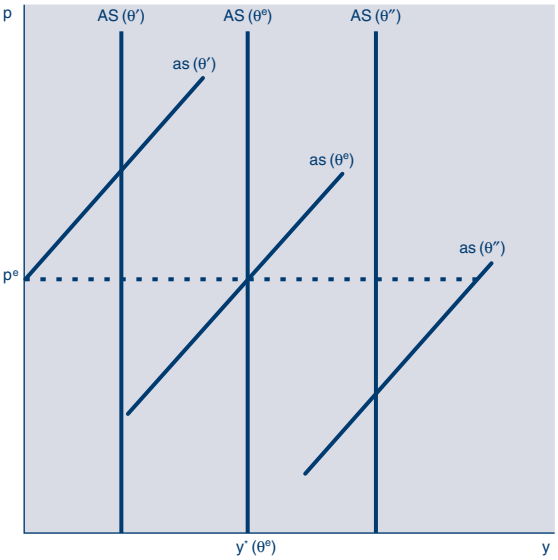
The intuition behind these results is straightforward. Consider, first, an unexpected increase in the price of output. For any given productivity realization, a surprise price increase lowers the real wage. Firms move down along their labor demand schedules, hiring more labor (and expanding production) as the real wage falls.[4]

Similarly, an increase in productivity causes firms' labor demand schedules to shift upward. In a market-clearing economy, the positive impact that this upward shift would otherwise have had on equilibrium hours is partially offset by an increase in the wage rate as households move out along their labor supply schedules. When the money wage is predetermined, this offset can occur only insofar as the productivity increase was expected. (Compare equation 5, which ap-

Figure 2

The Response of Aggregate Supply To Productivity Shocks

Holding the price level fixed at its expected value, the sticky-wage aggregate supply curve shifts farther in response to productivity shocks than does the flexible-wage aggregate supply curve.



plies to the market-clearing case, with equation 7.) Consequently, surprise increases in productivity have a larger positive impact on employment and output than do anticipated increases.

Graphically, the aggregate supply curve in a flexible-wage economy is vertical at y^*. In contrast, the aggregate supply curve in an economy with predetermined wages is upward sloping. Figure 1 depicts the case where $\theta = \theta^e$.

Although both aggregate supply curves shift to the right in response to a positive unanticipated productivity shock, the sticky-wage aggregate supply schedule shifts more. Similarly, a negative unanticipated productivity shock causes a larger leftward shift in the sticky-wage aggregate supply curve than in the flexible-wage aggregate supply curve (*Figure 2*).

Optimal policy. Competitive allocations are efficient. Consequently, policymakers will want to keep the sticky-wage economy as close to the market-clearing allocation as possible. However, the market-clearing levels of output and hours are not, in general, directly observable. Fortunately, this problem can be circumvented.

Consider a graphical representation of the monetary authority's problem. Figure 3, like Figure 2, plots three aggregate supply curves, one for the case in which $\theta = \theta' < \theta^e$, one for the case in which $\theta = \theta^e$, and one for the case in which $\theta = \theta'' > \theta^e$. The corresponding market-clearing output levels are denoted $y^*(\theta')$, $y^*(\theta^e)$, and $y^*(\theta'')$, respectively. The monetary authority would like the economy to end up at point A $\equiv [y^*(\theta'), p']$ in the first case, point B $\equiv [y^*(\theta^e), p^e]$ in the second case, and point C $\equiv [y^*(\theta''), p'']$ in the third case. More generally, the monetary authority would like to restrict the economy to the line passing through points A, B, and C. Everywhere along this line, $y = y^*$.

From equation 4, as θ rises from θ^e to θ'', the market-clearing output level rises by

$$y^*(\theta'') - y^*(\theta^e) = (1+\lambda)A(\theta'' - \theta^e).$$

From equation 9, the price level changes by

$$p'' - p^e = -(\alpha+\lambda)A(\theta'' - \theta^e).$$

Therefore, the line connecting points B and C has a slope of $-(\alpha+\lambda)/(1+\lambda)$, and the equation of the line passing through points A, B, and C can be written

$$(p - p^e) = -\left[\frac{\alpha+\lambda}{1+\lambda}\right](y - y^e)$$

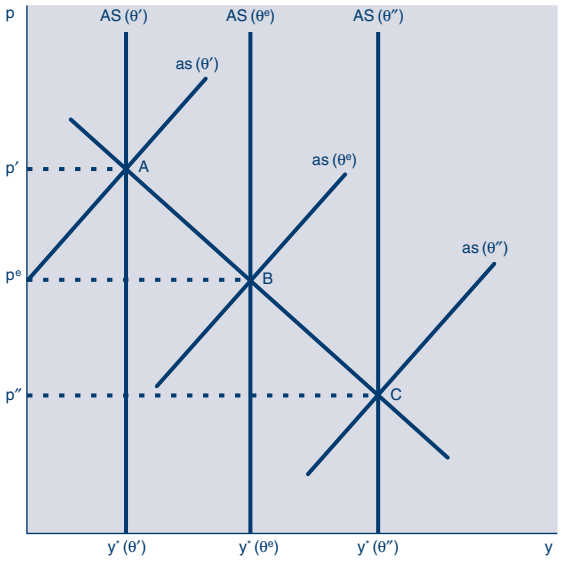
or, equivalently,

$$(10) \qquad p + \left[\frac{\alpha+\lambda}{1+\lambda}\right] y = p^e + \left[\frac{\alpha+\lambda}{1+\lambda}\right] y^e.$$

Figure 3

Optimal Monetary Policy

In a sticky-wage economy, optimal monetary policy calls for the price level to fall as output rises.



Thus, for the monetary authority to guarantee that period-t output is optimal regardless of the value of θ_t, it is necessary and sufficient that the authority adjust its policy instruments so as to set

$$p_t + \left[\frac{\alpha + \lambda}{1 + \lambda}\right] y_t = s_t, \tag{11}$$

where s_t is an arbitrary preannounced target. In the special case where the market-clearing level of employment is invariant with respect to productivity shocks ($\alpha = 1$), equation 11 reduces to a nominal spending target:[5]

$$p_t + y_t = s_t. \tag{11′}$$

Note that the optimal policy rule does not require that the monetary authority observe the realized values of productivity disturbances.

Insofar as the monetary authority is successful in implementing a policy rule of the form given in equation 11, it will appear that business-cycle fluctuations can be entirely attributed to aggregate productivity shocks—and this will, indeed, be the case.[6] However, it would be incorrect to use this observation as a basis for concluding that monetary policy is ineffective or unimportant.

The analysis presented above also illustrates a more general point: monetary policy and private contracting arrangements should be analyzed as a package. Clearly, optimal monetary policy depends upon private contracting arrangements. In the example above, the policy rule given in equation 11 would not be optimal (or even feasible) in an economy where it was the price level rather than the wage rate that was sticky.[7] Perhaps less obviously, private agents may rely upon the monetary authority to pursue policies that make complicated contingent contracts unnecessary.

Alternative versions of the optimal policy rule

We have seen that the optimal policy rule in a sticky-wage economy has the general form $p_t + ay_t = s_t$ (compare equation 11). No restrictions are placed on the price–output target, s_t, except for the requirement that it be announced one period in advance.[8] This section shows that a number of prominent proposed policy rules also have this general form. Some of these rules are nevertheless suboptimal, because they put too little weight on output. Other rules are optimal only under certain conditions.

Price-level and inflation targeting. Under a price-level target, s_t is a constant (or, more generally, a deterministic function of time), and a is set equal to 0. Under an inflation target, a is again set equal to 0, but s_t is defined to equal p_{t-1} (or p_{t-1} plus a constant).

Although the price-level and inflation targeting rules have the same *general* form as the optimal policy rule, they are not themselves optimal because they put zero weight on short-run output stabilization. In Figure 3, the price-level and inflation targeting rules would confine the economy to a horizontal line through point B, rather than the downward sloping line through points A and C. Consequently, output fluctuates too much in response to productivity shocks under these rules.

Imperfect Implementation of Optimal Policy

There is only a loose connection between variables that are directly affected by Federal Reserve actions (bank reserves and the federal funds rate) and the variables that enter the optimal policy rule: aggregate output and the aggregate price level. Consequently, the Federal Reserve cannot be expected to maintain the relationship displayed in equation 11 exactly. The unanticipated component of the error that the Federal Reserve makes in trying to implement equation 11 plays the role of an aggregate demand shock in the model economy.

To see this, let δ denote the current-period policy implementation error. That is, suppose that equation 11 is replaced by

$$p + \left[\frac{\alpha + \lambda}{1 + \lambda}\right] y = s + \delta,$$

where, as before, s is a preannounced target. This equation can be solved for p and substituted back into equations 8 and 9, yielding (after a little manipulation)

$$n - n^e = \left[\frac{1}{\alpha + \beta(1-\alpha) + \lambda}\right]\left[(1+\lambda)(\delta - \delta^e) + (1-\alpha)(\theta - \theta^e)\right]$$

$$y - y^e = \left[\frac{1+\lambda}{\alpha + \beta(1-\alpha) + \lambda}\right]\left[(1-\beta)(\delta - \delta^e) + (\theta - \theta^e)\right].$$

Hours respond positively to unanticipated policy implementation errors and ambiguously to productivity shocks.[1] Output responds positively to both unanticipated implementation errors and productivity surprises. Hence, the presence of implementation errors increases the chances that hours of work will vary procyclically. This effect is most obvious in the case where $\alpha = 1$ and is especially likely in the case where unanticipated implementation errors ($\delta - \delta^e$) are positively correlated with aggregate productivity shocks ($\theta - \theta^e$).

Substitute from the output equation back into the policy rule to obtain

$$p - p^e = \left[\frac{1}{\alpha + \beta(1-\alpha) + \lambda}\right]\left[\beta(1+\lambda)(\delta - \delta^e) - (\alpha + \lambda)(\theta - \theta^e)\right].$$

Thus, the price level responds responds positively to unanticipated implementation errors and negatively to aggregate productivity shocks. The real wage, of course, moves exactly opposite to the price level.

[1] As a technical matter, the anticipated component of the implementation error can always be folded into the preannounced target, s. That is, one can—without loss of generality—assume $\delta^e \equiv 0$.

More formally, if strictly adhered to, the price-level and inflation targeting rules imply that there are no price surprises: $p_t = p_t^e$. But equation 9 tells us that in a sticky-wage economy, price surprises must partially offset productivity surprises if the economy is to achieve the market-clearing allocation.

The Hall and Taylor output-gap rules. Robert Hall (1984) and John Taylor (1985) have proposed that the Federal Reserve adopt a policy rule of the form

$$(p_t - p_t^T) + a(y_t - y_t^T) = 0,$$

where p_t^T and y_t^T are a target price level and target output level, respectively, and where $a > 0$. Rearranging terms to obtain

$$p_t + ay_t = p_t^T + ay_t^T, \tag{12}$$

we see that the Hall and Taylor rules will have the same form as the optimal rule derived here provided that p_t^T and y_t^T are known one period in advance. Full optimality also requires that $a = (\alpha + \lambda)/(1 + \lambda)$.

In Hall's analysis, the price target is a constant. In Taylor's analysis, $p_t^T = p_{t-1}$. In either case, the price target is known as of period $t - 1$. Both analyses assume that the output gap, $(y_t - y_t^T)$, is stationary. Therefore, target output and actual output must have a common permanent component. If y_t is stationary about a deterministic trend, it is natural to set target output equal to trend output. The right-hand side of equation 12 will be known as of period $t - 1$. Consequently, the Hall and Taylor rules will have the optimal form. If output's permanent component is a random walk with drift, the situation is a little more complicated. It will not do to set y_t^T equal to current-period permanent income, because period-t permanent income is stochastic from the perspective of period $t - 1$. However, it would be consistent with optimality to set y_t^T equal to the *previous* period's permanent income plus a constant equal to the drift in permanent income.

Nominal income level and nominal income growth rules. The simplest versions of the optimal policy rule set s_t equal to a deterministic function of time or equal to $(p_{t-1} + ay_{t-1})$ plus a constant. In particular, if output growth varies about a well-defined long-run mean, $E(\Delta y)$, then setting s_t equal to $aE(\Delta y)t + s_0$ or equal to $aE(\Delta y) + (p_{t-1} + ay_{t-1})$—where $a = (\alpha + \lambda)/(1 + \lambda)$—will yield a policy rule that is optimal and that yields a zero long-run average rate of inflation. In the special case where $\alpha = 1$ (so that also $a = 1$), these definitions yield a nominal GDP level rule and a nominal GDP growth rule, respectively.

Discussion. How is it that so many seemingly very different rules can all be optimal? What matters for short-run stabilization purposes is only the relationship between *unexpected* price and output changes. Equation 11, which defines the optimal policy rule, leaves entirely open how this period's *expected* price level should depend upon past realizations of output and prices. Differences between rules along this dimension may have important implications for the distribution of wealth, particularly if debt contracts are specified in nominal terms. Additionally, some versions of the optimal rule may be easier than others for the monetary authority to implement. Such considerations are outside the scope of this article.

Summary and concluding remarks

Output and employment tend to be too responsive to aggregate productivity shocks in sticky-wage economies. Monetary policy can offset this tendency by allowing the price level to fall when output is high and allowing the price level to rise when output is low. Under optimal monetary policy, the economy responds to productivity shocks exactly as it would in a flexible-wage economy. Thus, despite a preset money wage, there are no $20 bills lying on the sidewalk: there is no loss of economic efficiency.

The optimal policy is sufficiently general in form to encompass several well-known policy proposals, including those of Robert Hall and John Taylor. In the realistic special case in which the market-clearing level of employment is independent of productivity, it is optimal for the monetary authority to target nominal spending.

It is, of course, possible that private contracts would adapt if the monetary authority insisted upon pursuing some policy other than that optimal in a sticky-wage economy.[9] The process of adaptation would likely take some time, however, and might never be complete. To minimize transition costs, a monetary authority choosing to implement some policy other than that optimal under current contracting arrangements would need to announce its intentions well in advance.

The particular modeling framework used in this article is unrealistic in its simplicity, and the details of the optimal policy rule derived here are sensitive to changes in model specification. However, minor changes in the model are unlikely to affect the article's principal conclusions:

1. In a sticky-wage economy, the Federal Reserve has a short-run output stabilization role to play.
2. Several variants of a given rule may have identical short-term stabilization properties. Consequently, in choosing between variants, distributional considerations and differences in ease of implementation will likely prove decisive.
3. The fraction of output variation that can be attributed to aggregate productivity shocks conveys little useful information about the importance or effectiveness of monetary policy.
4. The performance of a given system of private contracts is sensitive to the policy rule adopted by the monetary authority. Conversely, policies optimal under one system of private contracts may perform poorly under a different system. Thus, neither monetary policy nor private contracts should be analyzed in isolation.

Notes

Finn Kydland and Mark Wynne offered helpful comments for this article.

[1] The analysis extends Bean (1983) to the case where labor supply is derived explicitly from utility maximization—an extension that has important implications for the circumstances under which targeting nominal spending is optimal.

[2] See, for example, Fischer (1977), Gray (1978), and Taylor (1980).

[3] Perhaps relocation costs are negligible if workers switch jobs one period in advance and prohibitive otherwise. Then the labor market will be competitive ex ante and monopsonistic ex post. Workers will insist that some of the terms of their employment be spelled out in advance. Presetting the nominal wage, while giving firms control of hours, is an approach that is often observed in practice (Card 1990). The assumption that the wage is set equal to its expected market-clearing level is standard in the literature. In the model developed here, this assumption implies no loss of efficiency.

[4] If monetary-policy-induced price surprises were the primary driving force behind macroeconomic fluctuations, it would follow that the real wage ought to be countercyclical. Since the real wage is not, in fact, countercyclical, economists with strong priors that monetary policy drives the macroeconomy have in recent years tended to favor models of price stickiness over models of wage stickiness. See, for example, Ball and Mankiw (1994).

[5] In contrast, Bean (1983) finds that a nominal spending target is optimal only if labor is inelastically supplied—a problematic assumption when firms are given short-run control of hours. In general, a nominal spending target is optimal only if n^* is independent of productivity shocks. Because Bean uses an ad hoc labor supply function that lacks a wealth effect, the only way that he can make n^* independent of θ is by making the supply of labor independent of the real wage. In the model developed here, in contrast, n^* is independent of θ whenever $\alpha = 1$ (compare equation 6).

[6] The box entitled "Imperfect Implementation of Optimal Policy" discusses the behavior of the economy when the optimal policy is implemented with error.

[7] For discussion of optimal policy in an economy with sticky output prices, see Ireland (1994).

[8] More precisely, the target must be announced early enough that all labor contracts will be renegotiated before the target becomes binding. The real-world counterpart to "one period" is, thus, probably one to three years.

[9] This point is not new. According to Fischer (1977, 204), "An attempt by the monetary authority to exploit the existing structure of contracts to produce behavior far different from that envisaged when contracts were signed would likely lead to the reopening of the contracts and, if the new behavior of the monetary authority were persisted in, a new structure of contracts."

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